DEFORMITIES

A Text Book on Orthopedic Surgery

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PREFACE.

During the writer's experience as a teacher he has felt the great necessity of a comprehensive work on Deformities. To produce a book with subjects systematically arranged, and with a clear and concise delineation; brief, yet sufficiently elaborate to cover the ground, has been the aim of the author in preparing this work.

The book comprises many subjects not ordinarily included in works on orthopedic surgery. They have been incorporated here in order that the work should comprehend nearly all deformities that may be met with in general practice.

The chapters that contain subjects that are of rare occurrence, and especially those in which treatment is of but little avail, are handled briefly, while those deformities which are of common occurrence are detailed at considerable length.

The routine followed in writing of each deformity is as follows: Definition, Synonyms, Etiology, Morbid Anatomy or Pathology, Symptoms, Diagnosis, Prognosis and Treatment.

Under treatment, much consideration has been given to the *prevention of deformities*, as well as to their correction. Medical treatment, the treatment by the use of mechanical appliances, and the operative treatment have received a careful delineation.

Theoretical matter, and much technical matter, has been purposely omitted, and practical facts elucidated which are in accordance with the writer's experience in practice.

It has been the author's aim to prepare a text-book on orthopedic surgery which should be of assistance to the senior

classes in Medical Colleges, and a helpful work for the use
of practitioners whose experience with deformities has been
limited.

In addition to the matter usually contained in works on
orthopedic surgery, the writer has given in detail a description
of congenital deformities, and a general consideration of
hernia. These features, in the author's judgment, will greatly
increase the value of the work.

Due acknowledgment is hereby given to the works of
Young, Bradford and Lovett, Tubby, and the Transactions of
the American Orthopedic Association.

THE AUTHOR.

103 State Street, Chicago, April, 1898.

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ORTHOPEDIC SURGERY.

INTRODUCTION, DEFINITIONS, CLASSIFICATION.

CHAPTER I.

INTRODUCTION.

Orthopedic Surgery—History, Derivation, The Orthopedic Practice.

For at least one hundred and fifty years the term Orthopedic surgery has been in use, yet the boundary lines of the specialty have not been clearly defined.

Andry, of Paris, who has been generally regarded as the founder of this branch of surgery, declares that orthopedic means " to make a child straight. Gr. *orthos* straight, and *pais*, a child." Sayer of New York, in writing on the subject says, " that orthopedia being derived from two words, expresses in one term the design I propose which is to teach the different methods of preventing, and correcting the deformities in children." Gibney, in a more recent work, says, " the more generally accepted definition, is that branch of surgery which has to do with preventing and correcting deformities."

Some authors have made mechanical orthopedics, synonymous with orthopedic surgery, and hence they consider it sufficient only to be a good instrument maker or a good mechanic. Andry never intended to limit this specialty to the correcting of deformities solely by mechanical appliances.

There are numerous deformities which can only be corrected by surgical operation, and require the attention of one who is well skilled in operative procedure. In many cases secondary operations are necessary before relief can be obtained. In some cases the relief of the deformity will depend upon an operation performed on a remote part of the body, that the cause may be removed.

One who can recognize a condition or disease, which, if it continues to exist has a tendency to produce deformity, and can institute the proper treatment for its relief, practices orthopedic surgery. He who operates for the relief of any deformity in children or adults, practices orthopedic surgery.

In general the orthopedic surgeon must be skilled in diagnosis, and must be familiar with the clinical history of diseases, which have a tendency to produce deformity. He must, by judicious treatment, strive to cure the predisposing lesion as well as to correct the deformity. The methods of treatment may be either medical, surgical, mechanical, or moral. Many cases require all these methods combined.

Deformities that arise during the period of intra-uterine life, enter so largely into the consideration of orthopedic subjects, that the author desires to deviate somewhat from the ordinary plan followed in a treatise on these subjects, and briefly touch upon them in this work.

CHAPTER II.

DEFINITIONS AND CLASSIFICATION.

Orthopedic Surgery—Deformity—Congenital—Acquired—Malformation—Distortion—Monster.

Orthopædic surgery treats of the causes, the prevention and the correction of deformities in the human body.

Deformity is a morbid alteration in the form of some part of the body. (Dunglison.)

Deformities are either congenital or acquired. A *congenital deformity is one that exists at the time of birth; an acquired deformity is one that is developed subsequent to birth.*

Congenital deformities may be considered as either malformations or distortions.

A *congenital malformation* is a morbid alteration in the embryo in which there is an excess or arrest of growth, a doubling or an imperfect closure of embryonic tissues.

A *congenital distortion* is one in which the normal contour of the body is diverted or twisted out of shape.

A *monster* is an organized being having an extraordinary vice of conformation, or a preternatural perversion of every part, or of certain parts only. (Dunglison.)

The term monster or monstrosity is understood as being nearly synonymous with that of malformation. The former, however, is more often used to denote an extreme degree of perversion in congenital deformity.

SECTION II.
CONGENITAL DEFORMITIES.

CHAPTER I.

CLASSIFICATION OF CONGENITAL DEFORMITIES.

Complete consideration of all the congenital deformities would be by far too extensive to come within the scope of a text book on orthopedic surgery.

For a more complete detail of these subjects the reader is referred to works on teratology.

Classification only according to the manner of production will be attempted, showing the connection between the more common cases and those of a more complex nature. Treatment will be considered briefly where it is admissible.

In the following pages, monsters will be considered under the heading of malformations.

In the following tabulation, the classification embraces the main varieties of malformations. It presents at a glance a simple plan of arrangement of the subjects, which is based upon the manner of deviation from the normal development.

While the table does not give in detail every possible deviation, it is probable that it will comprehend within its scope nearly every case that may be met with in practice.

Each of the subjects herein contained will receive due consideration in the following chapters of this section.

CONGENITAL DEFORMITIES.

Malformations Produced by

- Variation in growth.
  - Excessive Growth.
    - Giants.
    - Congenital Hypertrophy.
    - Acromegaly.
    - Elephantiasis.
  - Arrested Growth.
    - Dwarfs.
    - Cretinism.
    - Congenital Atrophy.
- Division of Primary Cell-mass.
  - Double Monsters.
  - Doubling of Parts.
  - Supernumerary Parts.
    - Extremities.
    - Digits.
    - Syndactylism.
    - Arterial Nævus.
    - Venous and Capillary Nævus.
  - Congenital Tumors.
    - Lymphangioma.
    - Congenital Cysts.
    - Condyloma.
- Imperfect Closure of
  - Embryonic Openings.
    - Anterior.
      - Abdominal Hiatus.
      - Exstrophy of the Bladder.
      - Congenital Hernia.
    - Posterior.
      - Spina Bifida.
      - Meningocele.
      - Encephalocele.
      - Anencephalus.
      - Hydrocephalus.
  - Natural Openings.
    - Hare-Lip.
    - Cleft-Palate.
    - Epispadias.
    - Hypospadias.
    - Hermaphrodism.
    - Phymosis.
    - Imperforate Anus.
    - Absence of the Rectum.
    - Occlusion of the Rectum above the Anus.
    - Rectum terminating in Fistula.
    - Atresia Ani Urethralis, Vesicalis, Vaginalis.

Distortions.

- Congenital Dislocations.
- "   Club-Hand.
- "   Club-Foot.
- Rickets.
- Syphilis.

CHAPTER II.

MALFORMATIONS.

General Consideration of their Etiology—Formation of the Blastodermic Membrane, Epiblast, Hypoblast, Mesoblast—Experimental Teratology—Mechanical Influence—Maternal Influence—Heredity.

In treating of malformations we must necessarily consider briefly the earliest development of the human body. The earliest development of animal structure is from the embryo. Beginning with a cell matrix, there is a gradual change in, and proliferation of embryonic cells until the body assumes definite form. It is during this period, or about the first three months of intra-uterine existence, that a deviation from the normal development begins, resulting in congenital deformity.

Segmentation in the embryo takes place about the thirteenth day after fecundation, and afterwards the blastodermic cells form and are arranged into the blastodermic membrane. The blastoderm is split into an external or serous layer, and an internal or mucous layer. The intermediate layer is formed by a genesis of cells from the two opposite surfaces of the above named layers. The three layers of the blastoderm have been called the epiblast, hypoblast and mesoblast, and from these the structures of the new body are formed. A regular and symmetrical proliferation, or folding and uniting of the cells of these membranes results in a regular and symmetrically formed body; a failure in this process gives rise to congenital deformity.

Experimental teratology has of late cast much light upon this subject, and the possibility of the artificial production of deformity. While the experimental investigations have been limited to the lower forms, and the results cannot be directly

applied to man, yet they are of value in pointing out similar changes which may take place in the human embryo.

MECHANICAL INFLUENCE.

Geoffrey Saint-Hilaire was among the first to experiment. He succeeded in modifying chick embryos by different positions of the egg while hatching. Teharzik placed eggs vertically; and, in some cases with the larger end uppermost, and in others, the smaller; with the result that increased nutrition of either head or tail in the lower end of the egg was plainly manifested. Dareste produced many malformations, such as exancephalus, cyclocephalus, spina bifida, etc., by having the eggs violently shaken by a machine for some twenty minutes before incubation. Wilson claims to have produced many malformations, and also double monsters, by shaking the embryo during the time of early cell division. Duesch and Richter were able to produce dwarfs and other monstrosities by a continuous slight elevation of temperature while hatching. Girlach influenced the medium of oxygen on eggs and was able to produce monstrosities of various shapes.

In reviewing these experiments one is impressed with the fact that certain mechanical influences brought to bear on the embryo, such as violent agitation, thermic variations, restricted oxygen, and disturbed nutrition are capable of producing an effect on the earlier embryonic cell-mass, and inducing deviations from the normal type. We can readily understand how the same morbid changes can take place in the human embryo, from agitation or profound excitement, sameness of position, high or low temperature in the mother, and accidents of various kinds during the earliest weeks of pregnancy, which may act as mechanical influences in causing deformity. There is, however, much to be proven in this connection.

Maternal Impressions.

The influence of maternal impressions in the causation of malformations, is largely a matter of individual opinion. It is denied by some observers, while many others believe in it. I need hardly add that it is a very general popular belief, supported by numerous cases. Most authors admit that the hereditary forces which normally reproduce typical forms may be checked or diverted by other forces, which exert a profoundly abnormal influence, chiefly through the nervous system. There is undoubtedly some functional and structural connection between the body of the mother and the new germ cells, but just what the connection is, or how a sudden emotion on the part of the mother can mark the child, science has yet to determine.

Heredity.

Heredity, undoubtedly has much to do with certain cases of malformation, as in many instances the deformity can be traced through previous generations. In some families the peculiarity might be absent for one or more generations and make its appearance later. The hereditary tendency may manifest itself more strongly in some members of the family than in others. The transmutation is liable to occur either through the male or female.

Barn, in his experiments with fresh eggs, substantiates the fact that the ovaries of certain females showed a special tendency to yield double monsters, the predisposition remaining constant and unchanged, notwithstanding the fact that the male had been changed. According to Herrick, heredity figures as a predisposing factor in some obscure way, but the exact methods of transmission has not as yet been pointed out.

CHAPTER III.

EXCESSIVE GROWTH.

Giants—Congenital Hypertrophy—Acromegaly—Elephantiasis.

GIANTS.

Giants are persons of extraordinary growth, reaching a height of more than seven feet. The body is generally well proportioned with the exception of the head, which is usually undersized, as compared with the rest of the body. The giant growth is well distributed throughout the body. The face is in proportion to the head; the hands and feet in proportion to the body; and the outline of the bones and body in general are symmetrical. The growth is usually reached at the age of twenty-one. These are examples of true giantism; as a rule they remain thin and spare. When born they are usually of ordinary size and the parents probably of medium stature.

Observation goes to show that, generally speaking, large offspring are from large parents, but it is seldom the case with giants. They are generally sterile and short lived. The tendency to excessive growth is present from birth and there is no preventive treatment known.

CONGENITAL HYPERTROPHY.

Congenital Hypertrophy can occur in a part of the body, as in either the lateral half of the body, in a leg, a finger or a toe. Growth, or excessive development of a part, may reach an extraordinary degree, while all other parts of the body remain normal. The tendency to overgrowth begins in the embryo; but, as a rule, it is not manifested at birth. (Roswell Park, Treatise on Surgery.)

As the child grows, the hypertrophy gradually becomes evident. The excessive development is in all the structures of the part, and where it occurs in the lateral half of the body, or in an extremity, care must be exercised lest the diagnosis is made one of atrophy of the normal limb instead of hypertrophy of the corresponding one. The excessive growth con-

Fig. 1.   Congenital hypertrophy of the lower extremities.
(Case of Dr. Graefe.)

tinues till adult life, and attains great proportions without participation of the adjacent parts.

Hypertrophy should not be mistaken for asymmetry in the adult. Measurements have been made by Hunt, Wright, Cox, Morton, and others, of a large number of males, and they found a difference in the length of the lower extremities of from one-eighth to one inch as a normal characteristic. Asymmetry occurs in some degree in a large percentage of human beings, there being few persons whose extremities are of exactly the same length and size.

Treatment. The treatment in mild cases consists in restoring symmetry and equilibrium by artificial means. To prevent lateral curvature, braces should be worn, and the

Fig. 2.   Congenital hypertrophy of the lateral
half of the body.

shorter leg should be lengthened artificially to correspond with the other, and in this way assist in maintaining the equilibrium of the body.

In severe cases amputation is the only effectual remedy. This should be resorted to early, provided it is an extremity, or one or more digits. It is best to operate in early childhood before the patient arrives at an age when the deformity will

Fig. 3.   Congenital hypertrophy of the middle finger in a boy thirteen years old.   (Ridlon.)

cause mental distress.   Treatment by pressure, to diminish the amount of nourishment in the hypertrophied part, has been practiced, but without marked success.

ACROMEGALY.

Acromegaly is a progressive increase or overgrowth of the bones, muscles, nerves, connective tissue and vascular organs
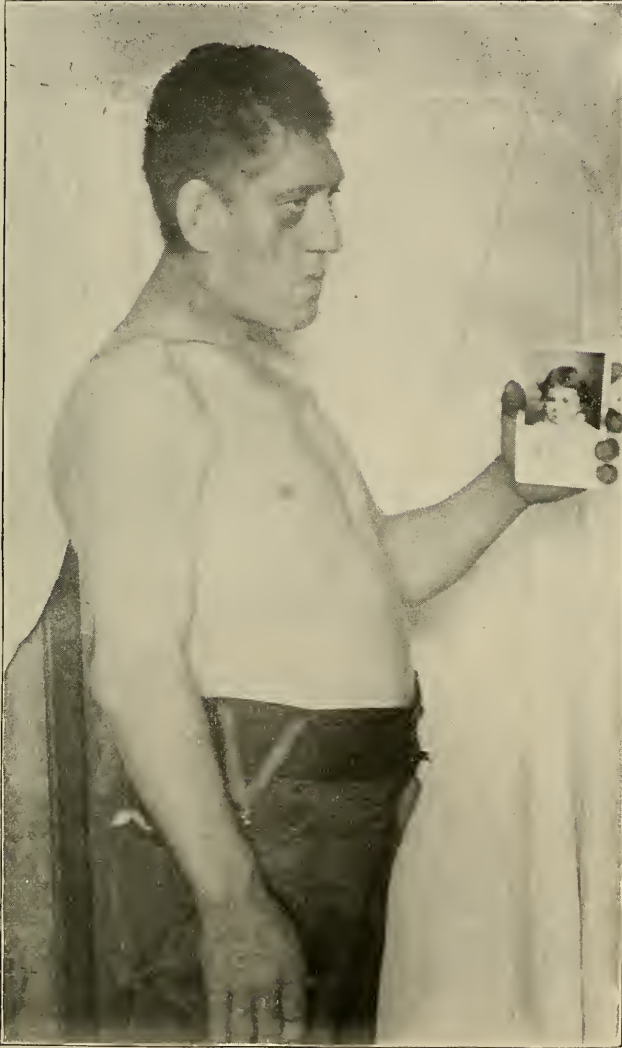
Fig. 4. Acromegaly. Circumference of head thirty inches. Enormous development of the bones.

in the whole body; and is usually most manifest in adult life. The over development is in lateral dimensions; and, though nearly symmetrical, is most marked in cancellous bone tissue throughout the body.

The structures involved in the excessive growth are those which are derived from the mesoblast in the embryo, that is, the bones, muscles and circulatory structures. In these structures the growth is toward giganticness. The parts of the body appearing most prominent is about the epiphyses of the bones. The frontal eminences and superciliary ridges become very large; the lower part of the face heavy; and the hands and feet of an enormous width and thickness.

There is always some kyphosis. Although the appetite is always good there is not an increase of flesh. They complain of dull headache, disturbance of vision, severe joint pains, and ringing in the ears, while the voice is coarse and hollow.

Dull aching pains in the head are probably due to pressure on nerves or nerve centers, and to a sluggish circulation. The same may be said of pain in the bones and joints in general. In addition the patient is liable to attacks of ordinary diseases, such as rheumatism, anæmia, and chronic organic affections.

General medical treatment is often indicated for the relief of these ordinary troubles, but so far as known at the present time there is no treatment that will arrest and correct the overgrowth.

Elephantiasis.

Elephantiasis is a hypertrophy of the skin and subcutaneous tissue. Its most usual location is in the lower extremities, and the genital organs. In some cases nearly the whole body may be affected, but in these the most marked development is in the lower extremities. It may be present at birth, or may begin at any time in life, but it is generally most marked in the adult.

Elephantiasis has its origin in the embryo, in the epiblastic

tissue. The deformity develops as a hypertrophy of the structures derived from that membrane. (See Lymphangioma.)

The excess of pigment is also marked.

Fig. 5. Elephantiasis. (Laidlaw and McIntire.)

The local inflammation, the eczema, the cracking of the skin and the escape of lymph, are results of the hypertrophy,

rather than the primary lesion, and are caused by the low vitality of the parts affected.

It is held by some authors that elephantiasis is acquired and has its origin from a germ, but this hypothesis is not proven.

Fig. 6.   Congenital elephantiasis of the lower entremity.   (Park.)

Where the elephantiasis is late in developing, the *vis vitæ* in the defective embryonic cell growth is latent, and is afterwards aroused to activity by external influences—physiological or pathological.

Patients with elephantiasis do not suffer much, and they usually live to a good age.

Treatment is of no avail unless the hypertrophied parts can be amputated. Local and general palliative treatment can accomplish something by way of relieving the eczema and other lesions of the skin.

CHAPTER IV.

ARRESTED GROWTH.

Dwarfs—Cretinism—Congenital Atrophy.

DWARFS.

Dwarfs are persons whose growth is arrested, and who are less than four feet in height. The body is well proportioned, except that the head usually is large and the legs short.

Generally as infants, nothing abnormal is observed, but later arrested development is evident. Usually the development of mind is arrested, and it remains childlike. Cases have been described as true dwarfs where there seemed to be an absence of any pathological condition. In these cases it is plain that the tendency towards arrested growth was from birth, though the retarded growth was not noticed for some months afterwards.

CRETINISM.

Cretinism is a term adopted of late years to designate an arrested development of the entire body. It is claimed by some authors that cretinism is a disease having an intimate, though obscure relation to disease or absence of the thyroid gland.

If there is a pathological connection between the arrested growth and the thyroid gland, it is difficult to determine positively whether the original defect is in the gland, or whether general arrested development is the cause of the defective gland.

It has been proven that cretinism does not occur any more frequently in localities where goitre prevails, than it does elsewhere.

The theory that cretinism is caused by a defect in either

the ovum or the spermatozoon—the influence of which remains during the period of development, is the most plausible explanation.

In most cases some of the characteristics of cretinism are present at birth; generally, however, the symptoms are not noticed until about the sixth month.

Fig. 7. Cretinism. Age twenty-four years; height thirty-four inches; weight forty-seven pounds; features characteristic.

In the cretin the body is fat, tumid and weak; the skin is brown or of an ashy tint; the head is large; and, if a young subject, the fontanelles are widely open; the face is large and

expressionless, and the features are characteristic; the extremities are very short, fat, weak and the patient is bow-legged; and the abdomen is large and protruding.

If a child, it is sleepy and appears indifferent to light and sound; growth is very slow, and walking is delayed until about the sixth year; puberty is late or does not appear at all.

Fig. 8. Back view of Fig. 7. Skin wrinkly; no pubic hair; shy and affectionate. Can speak a word or two.

In stature cretins range from about three feet to four feet six inches. Their actions remain infantile—timid, affectionate, and they talk but very little. Their mental deficiency varies;

some are very stupid and sleep the greater part of the time, and it is difficult to wake them; others are more lively, but when questions are asked them they answer in a childlike manner.

Treatment. During early life a cretin should be treated on general principles;—fresh air, frequent baths, nutritious diet and medication as is indicated.

The hypophosphites of lime and soda will be of benefit in strengthening the frame work of the body. Late reports show that the administration of thyroids as medicine, has produced good results. The mental faculties may be developed by proper training. Deformity of the bones is to be treated as in other cases of deformity.

Congenital Atrophy.

The arrested development of a part of the body, embraces malformations varying in degree from a rudimentary finger to a shapeless acardiac monster.

Fig. 9. Congenital deficiency of the lower extremities. (G. E. Shoemaker.)

In atrophy the nutrition is impaired but not absolutely arrested. (Examples of natural atrophy occur shortly after birth in the disappearance of the hypogastric arteries, the ductus arteriosus, vitelline duct, the wolffian bodies, etc.)

The causes to which the impaired nutrition is due may be general—affecting the entire organism, or local—exerting their unfavorable influence on a very limited area. In the latter
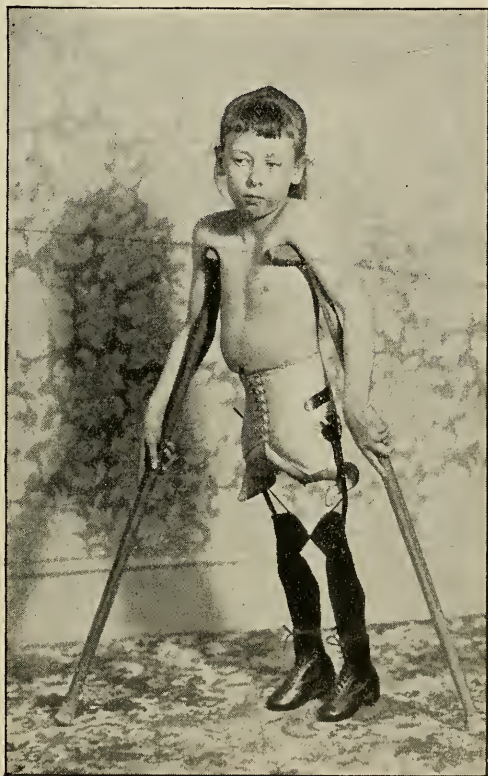
Fig. 10. Congenital deficiency of the lower extremities. Walking apparatus applied. (G. E. Shoemaker.)

cases the atrophy may be mechanically induced as the result of undue pressure, or it may be due to violence done to the embryo.

It is pretty well agreed by writers or authorities at the present time, that such defects have their beginning at a very early period of embryonic existence. The defect is un-

doubtedly present as an arrested development at the period when the extremities are formed. This is true even in the hereditary cases, where the defect has passed through several successive generations.

Fig. 11.   Congenital deficiency of the fingers.   The rudimentary
process webbed.

The theory that at this early period the amnion is disturbed, the membrane becoming inflamed resulting in plastic exudation, which causes adhesions, constrictions, and arrested formation, will suffice in this place.

The most interesting of these cases to the orthopedist, are

those where there is an arrested development of the extremities so as to impair their usefulness. The writer has examined two cases where the upper extremities consisted only of rudimentary hands at the shoulders; and has also seen one case where a lower extremity was useless, due to the *deficiency* of the bones of the leg.

Treatment will depend upon the degree of the deformity and the parts that are undeveloped.

If it is a useless dangling extremity, it should be amputated while the child is young. If there is any muscular power in the part, it should be retained and utilized in the management of some mechanical device. A mechanical contrivance will be found of great service to assist these persons in locomotion, if the congenital deficiency should be in the lower extremities.

CHAPTER V.

DIVISION OF PRIMARY CELL-MASS.

Double Monsters—Doubling of Parts—Supernumerary Parts—Extremities—Digits—Syndactylism.

DOUBLE MONSTERS.

In double monsters we have an example of the most conspicuous deviation from the normal type. The variation in the manner of the union of these bodies is great. The Siamese Twins was an example where two well formed bodies were joined together by a narrow isthmus.

The *ischiopagus, cephalopagus,* and *rachipagus* are examples where union is that of a considerable portion of the body, as of the buttocks, head or spine.

Some cases represent that of a partially developed body hanging as a parasite to a nearly perfectly formed body. The development of a parasitic body varies from that of an anencephalar body, to that of a mere rudiment hanging by a pedicle. Writers on the subject of tumors have given these parasites the name of *teratoma.* (Sutton.)

Double monsters are supposed to have their origin from the single embryo, the same as other malformations, instead of originating from the union of two or more ova as was formerly claimed. "The once generally accepted and brilliantly supported theory that double monsters resulted from the fusion of two separate and independent embryos, may be regarded as now entirely obsolete. Modern embryologists agreeing at least so far, that multiple monsters arise from a single ovum." (Piersol in Reference Hand Book of Medical Sciences.)

The theory is that the primitive embryonic cell-mass may undergo division in a varying degree. When the division is

complete the resulting halves are capable, under favorable conditions, of developing into twins. When incomplete the divided parts may subsequently separate, while the attached portion constitutes the band of union.

A repetition of division may take place in the embryo, thereby producing a third division of the cell-mass; which, in case of nearly complete fission would develop into triplets. Not unfrequently, however, the divisions are effected by unequal development, the variation becoming more marked as
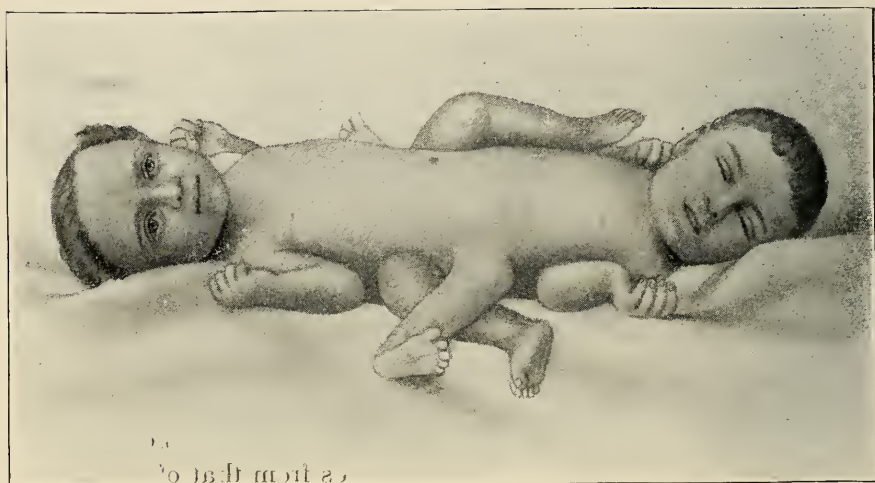
Fig. 12. Ischiopagus. These children were exhibited in Chicago and examined by the writer in 1889.

growth advances. In cases where the weaker division of the embryo becomes more and more dependent upon its stronger mate, and the difference becomes pronounced, it results in the formation of a parasitic monster.

Examination of the dead bodies of double and parasitic monsters, has revealed the fact that the internal organs and the circulation of the one, is common with that of the other.

Treatment. Operative treatment for the purpose of dividing the bond of union of double monsters has failed.

Attempts made for the removal of the dead body of one monster to protect the life and health of the other attached one has also failed.

Doubling of Parts.

Contrasted with the double monsters, we have the doubling or dividing of embryonic cell areas into individual organs. Duplications of this character affect almost every important viscus in the body. The duplication occurs very early in embryonic life, or at about the time the organs are produced by the process of proliferation of the embryonic cells. Examples of this kind of malformations are seen in the doubling of the organs of sense, as the eyes, nose, or ears; the doubling of in-
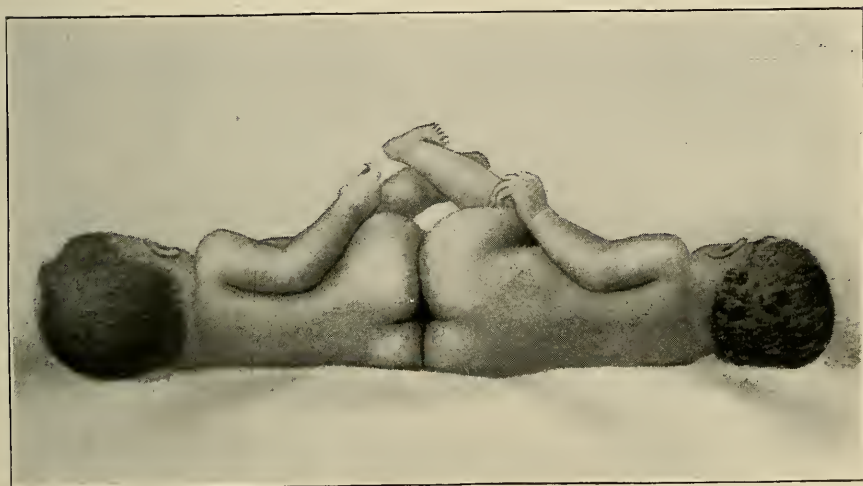
Fig. 13. Same case as Fig. 12. Back view, showing the deep cleft in which are the orifices.

ternal organs, as the heart, lungs, kidneys, uterus, etc., and the doubling of the mammæ or genital organs.

As a rule, in cases of marked doubling of organs, the fœtus is dead at birth, or death takes place shortly afterwards.

For treatment of these cases of doubling, especially of the internal organs of the body, the reader is referred to works on general surgery. It is sufficient to say in this connection that in the more simple cases the parts should receive such operative or other treatment as will bring them as near to the normal type as possible.

SUPERNUMERARY PARTS—EXTREMITIES, DIGITS.

Polymelia, polycelia, polypedia, polybrachia, polymania and polydactylism, are a series of terms applied to deformities meaning, many limbs, many legs, many feet, many arms many hands, and many digits. Medical literature contains numerous illustrations of each of these forms.

Polydactylism is by far the most common. It may be unilateral or bilateral, and in some cases it presents quite a symmetrical appearance, while in others the supernumerary extremities, or digits, may be much under size. The parts
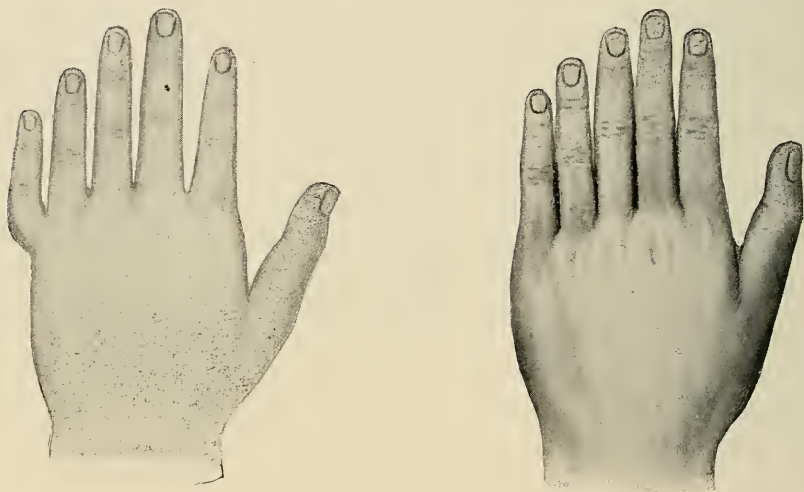
Figs. 14 and 15.   Supernumerary Fingers.
(Polydactylism.)

may present a webbed appearance, or be free from each other. In some cases there is multiplication by regular order, while in others, irregularity prevails. Examples vary from an extra digit hanging by a pedicle, to that of any form of bifurcation.

During the fifth week of embryonic existence, four prominences or embryonic ends appear, and from these are developed the extremities. The process is that of the proliferation of cells, and elongation, until about the eighth week, when the interdigital clefts make their appearance. It is during this period that the deviation occurs.

Not infrequently we have observed the same malformation in different members of the same family. In some cases it may be present in succeeding generations, while in others it may skip a few generations, and make its apearance later.

Treatment. Amputation should be practiced especially where the deformity is such that it can be done and leave a useful extremity.

Persons afflicted with such a malformation are usually sensitive about it; and, for this reason, amputation should be resorted to as soon as possible. Generally speaking, it is better to leave a scar or a stump, than to leave one of these multiplications.

The operator should exercise great care in performing the operation so as to remove bone and soft parts effectually, and in such manner as not to weaken the remaining structures of the extremity.

Syndactylism.

Syndactylism, or webbed fingers and toes, is often associated with the other deformities of the extremities. Cases presenting supernumerary parts, or those presenting hypertrophy, atrophy or arrested development, are liable to also present syndactylism to a variable degree.

The webbing of the fingers and toes present a variety of examples. All the digits of each extremity may be webbed; or, commonly, two digits on each extremity are connected. It may appear on one or more extremities and not on the others. The attachment may exist throughout the whole extent or only through a part of their length.

The union of the digits may consist of only a web of skin and areolar tissue, or the fingers may be more intimately fused together by muscle and fibrous tissue, as well as by skin; or the bones of two fingers may be fused together by their terminal phalanges, or, in rare instances, throughout their whole extent.

Treatment. Treatment consists of such operative means as will separate the structures, and retain their usefulness and normal appearance. The difficulty encountered in these

cases is, first; the great tendency of the extremities to re-
unite; and, second; a possible resulting deformity from cica-
tricial contraction of the fingers. The author has overcome
the first difficulty by introducing through the tissues at the
lowest point of the intended division of the fingers, a silver
plate of the desired shape, and allowing it to remain *in situ*
for some months prior to the operation, so that the epi-
thelium may grow into the opening, thereby making a good
base for the cleft.

The second difficulty is overcome by making good skin
flaps to cover raw surfaces. In one case operated upon, there
was only skin enough to cover every other finger. Here, skin
grafting was resorted to, to hasten the healing process.

Following any operation on the fingers, it is necessary to
keep them well padded and extended on splints, to prevent
contraction.
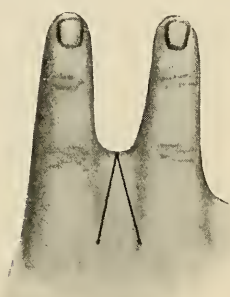
Fig. 16.   Form of triangular flap to
be raised in operating for webbed
fingers.

Fig. 17.   Dorsal flap brought be-
tween the fingers and stitched
on the palm.

Where there is an abundance of webbed tissue between
the fingers, the operation is quite simple. In some cases, the
fingers may be separated by incision, and held apart by oiled
lint, till cicatrization is complete. In other cases, a V shaped
flap can be cut from the dorsal surface of the face of the web,
with the apex anteriorly, extending through one-half of the
thickness of the band. The flap is then dissected back, the
remaining portion of the web slit longitudinally, the flap drawn
through the cleft at the base of the fingers and stitched.

The operation by Didot consists of a palmar flap from one finger, and a dorsal flap from the adjoining one, the flaps ex-

Fig. 18. Syndactylism.
Outline for the palmar flap.
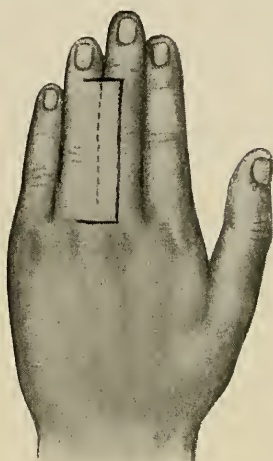
Fig. 19. Syndactylism.
Outline for the dorsal flap.

Fig. 20. The webbed fingers separated. The flaps
to be sutured around the fingers.

tending to the middle of the fingers; the remaining web is divided and the dorsal flap of one finger covers the palmar surface of the other. The separation of webbed toes needs no special consideration as the deformity is concealed and is not an impediment to locomotion.

CHAPTER VI.

DIVISION OF PRIMARY CELL-MASS. (Continued.)

Congenital Tumors—Arterial Nævus, Venous and Capillary Nævus, Lymphangioma, Congenital Cyst and Hydrocele, Dermoid Cyst, Condyloma.

Congenital Tumors.

Under this heading we include all those errors in development that appear in early life, and are commonly known as tumors, nature's or mother's marks, moles, cysts, and excrescences of various kinds and of varying degrees.

Embryonic errors of this character although seemingly very small and trifling in childhood, commonly develop into growths of a serious nature later in life.

The theory is that during the formation of the embryo, certain cells of one embryonic structure are displaced and lodge in another, and remain isolated and in a state of incomplete development until later, when the dormant force is aroused and growth begins.

Dr. Senn, in his work on tumors, says: "In the absence of a more plausible theory, I am forced to conclude that every tumor is the product of tissue proliferation of a congenital or post-natal matrix of embryonic cells, aroused into activity by a general or local physiological stimulation, or by congenital or acquired abnormal conditions in its immediate environment."

Cohnheim states that tumors are entirely of embryonic origin and are due to an anomalous arrangement of cells.

A displaced matrix of embryonic epithelial cells, isolated from the epiblast or hypoblast, and buried in the mesoblast, may remain dormant for a long time; but when growth begins it is epithelial in character, and may present wonderful cell

proliferating power. This is also true with regard to misplaced cells from the other blastodermic tissues. Embryonic deviations of this kind are most liable to take place at or near the place where the blastodermic membranes join, as about the apertures of the body.

Cells may become isolated and develop into tumors in any portion of the body. The dermoid cystic tumor furnishes an example of embryonic cell division and isolation.

We will only consider briefly those congenital tumors which present themselves in early life.

Nævus.

The nævus is a common tumor composed chiefly of an enlargement of the vessels, and is supposed to be displaced mesoblastic cells. At the commencement, it is slightly elevated and of a reddish color, and is usually soft to the touch. These tumors vary in size from that of a pin head to that of a silver dollar, or even larger. They occur on the surface of the body, and most commonly on the face and neck, presenting oftentimes a very unsightly appearance. These tumors are also called telangeiectasis, angeiomas, mother's marks, portwine marks, etc.

Nævi or vascular tumors, present several different varieties. They may be arterial, venous, capillary, lymphatic, and, in some instances, all these combined.

Where the vessels become extremely enlarged, forming cavities of considerable size, the tumor is called a *cavernous angioma*.

Arterial nœvi are of the nature of aneurysms and appear either as a dilatation and lengthening of arteries—aneurysms by anastomosis; or as a dilatation and lengthening of an arterial stem and its branches.

Cirsoid aneurysm. The arteries lose their uniform caliber, and undergo irregular dilatation, at times becoming *sacculated*. The tumor obtains its arterial supply from all directions, and usually, their feeding arteries are increased in size. The pulsation in the tumor is hard, and is compressed with difficulty.

The tumor increases in size by dilatation of the arteries within and adjacent to it. These tumors may occur anywhere in the body, and involve deep as well as superficial structures.

Venous and *capillary nœvi* occur more frequently about the nose, eyelids, lips, cheeks and ears. A nævus of this variety may be first seen as a mere speck, which gradually increases in size until it presents a hideous appearance.

Fig. 21. Capillary nævus—Progressive.

The veins and capillaries become enlarged and engorged; the adjacent vessels undergo a like change, until the tumor is a mass of twisted and irregular sacculated vessels. The vessels are easily compressed, but on removing the pressure the blood quickly returns in the tumor. The surface is either

smooth or rough, and may be covered with hair. The color is usually red, but in some tumors there is a deposit of pigment giving a blue color. Portwine marks are of the capillary variety, and are usually smooth; and, in some cases, are very large and irregular in outline. These marks are level with the skin, and do not increase in size.

Fig. 22.   Large pigmented nævus.   Progressed from a small capillary nævus.

Lymphatic nævus or *lymphangioma*, is a mass of dilated lymph vessels, and when occurring in the skin has been called elephantiasis. It may be small in area, or occupy a consider-

able portion of the body. The surface of the tumor usually shows more pigment than the surrounding skin, and is hard and rough to the touch. The enlarged lymph vessels contain a colorless fluid. The underlying veins are somewhat dilated; and, together with the enlarged lymphatics and hypertrophied epithelium, form the tumor. It is supposed to be due to an over development of the epiblast. (See Elephantasis.)

Diagnosis is not difficult, as the tumors are usually superficial and can be easily manipulated. Careful observation should be made from time to time to determine if the veins are enlarging; if so, treatment should be instituted at once.

Prognosis. These tumors are more or less prone to ulceration, and in such cases there is danger of hemorrhage; otherwise the general health of the patient remains the same. Some nævi do not increase in size, and others may begin to grow at any time during life. Treatment is usually effectual.

Treatment. The methods that have been pursued in the treatment of nævi are many. Those most in favor are excision, electrolysis, ligation, the seton, vesication, vaccination, caustics, coagulating injections and the actual cautery.

If treatment is instituted early, and the nævus is very small, the application of a small quantity of caustic, as nitric acid, will usually take it away. Generally when these tumors show a tendency to increase in size, the most effectual treatment is excision.

If the nævus is arterial, the cutting must be done far enough away from the base of the tumor to insure its complete removal. A good supply of artery forceps and competent assistants should be at hand, as in some cases we have to contend with an unusual number of spurting arteries. After excision, the wound is closed with sutures and heals by first intention, leaving scarcely a perceptible scar.

If the excised nævus leaves so large a gap that the integument cannot be drawn together without too much tension upon the sutures, it is best to raise a flap from the adjacent tissues, and turn it into the wound in such a way that there will be no tension when the stitching is completed.

In operating for ordinary nævi, the parts are anæsthetized by injecting a few drops of a two per cent solution of cocaine into the base of the tumor, and an elliptical incision is made so as to include the tumor and a portion of the integument. The tumor being removed, the resulting wound is brought together by sutures in the usual manner. The operation is almost painless.

Nævi may be destroyed by electricity. This is done by puncturing the nævus about its base with a small needle attached to the negative pole of a galvanic battery; the positive pole, with a wet sponge attached, being held in the patient's hand. From two to eight volts should be used, regulating the current so as not to cause too much pain. The needle should be withdrawn when a white bubbling occurs around it, and introduced into the base of the tumor from another direction. This treatment should be continued for ten or fifteen minutes, and can be repeated again in ten days, if it should be found necessary. The electric current applied in this manner produces a chemical decomposition of the structures composing the base of the tumor.

Ligation is done by either passing a pin under the nævus, and throwing a ligature around its base below the pin; or by passing a double ligature through the base and tying it in two halves. The ligatures are to be left on until the nævus drops off.

In treating nævi, care should be exercised not to excite suppuration, or to make unsightly scars. The use of the seton may be followed by undue suppuration, while coagulating injections may jeopardize the life of the patient by producing emboli.

Congenital Cysts.

A cyst is a tumor composed of an envelop or cyst wall enclosing a cavity filled with a fluid or semi-fluid substance. The cyst wall is composed of secreting endothelial or epithelial tissue and is supposed to originate from misplaced epiblastic cells.

The contents of the cyst cavity is often offensive in odor

and of varying consistency, being composed of fatty matter, epithelial debris, and cholesterine crystals, sometimes containing a few hairs, some of which may be attached to the inner surface of the sac.

The location and character of cysts varies greatly. The most common ones making their apperance in early life, are the hydrocele, dermoid and sebaceous cysts.

Hydrated cysts or *hydrocele.* These may occur in almost any part of the body. Their envelop is soft and secretes a watery fluid. These tumors sometimes attain large proportions.
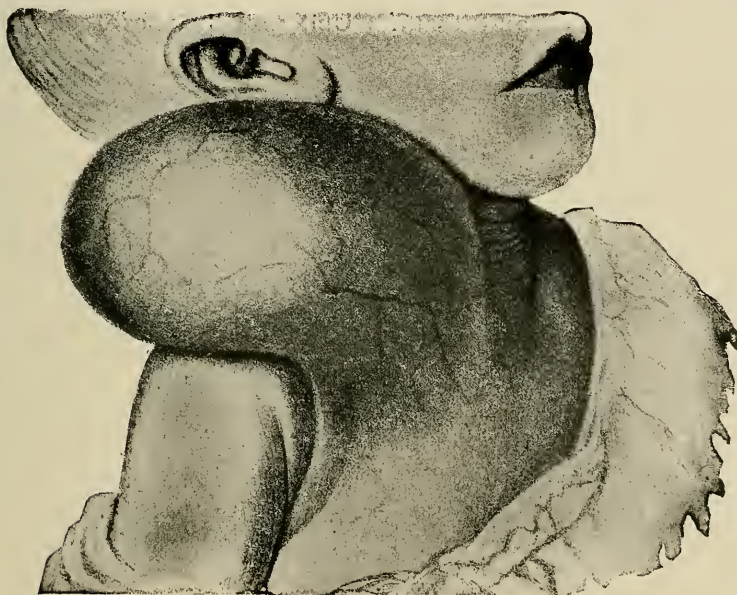
Fig. 23. Congenital hydrocele of the neck. (Park.)

The proper treatment is to evacuate the fluid by tapping with trocar and canula; or by open incision, thereby causing adhesive inflammation in the cyst wall, and consequent obliteration of the sac; or evacuation of the contents of the hydrocele, injecting into the sac a solution composed of specific thuja one part to sterilized water two parts. Tincture of iodine one part to five parts of distilled water is good treatment, especially where the cyst cavity is of small size.

If the hydrocele is very large, and a portion of it extends into extremely sensitive tissues, some caution is necessary for fear the application of irritating medicine should cause too extensive an inflammation. The writer has had an unpleasant experience from the injection of the tincture of iodine into the cavity of a large hydrocele of the neck.

Dermoid Cysts are most frequently situated about the embryonic openings. They contain remains of true skin, sebaceous glands, hair-follicles, hair, etc., together with a degenerated fluid. A more complicated form of these tumors reveals, in addition to the above, the presence of even muscular tissue, bones and teeth. Undoubtedly these complex forms result from an encysted parasitic monster. Dermoid cysts vary greatly in size and disfigurement.

Diagnosis must be made by careful manipulation, and when necessary, by puncture. Where the tumor is large, great care should be taken to determine any attachment to a vital part, as in such a case its removal would be both difficult and dangerous. In these cases the tumor should be carefully and completely dissected out.

CONDYLOMATA.

Wart-like excrescences are growths which occur with comparative frequency about the face, neck, arms, or on the genitals. They occur in all shapes and they vary greatly in size. They may be smooth or rough. Some have a broad base and some are pedunculated. They are also known as *verruca*.

Condylomata that are large and rough are usually accompanied by a very fetid discharge. This is especially true if situated near the anus or on the genitals. Their tendency is to increase in size and number. They resemble the syphilitic vegetations in the adult. The appearance is sufficient to establish a diagnosis.

Treatment. Specific Thuja, well rubbed into these excrescences twice a day will usually produce a cure. Persulphate of iron in powder, is also a valuable application.

The excision of a portion of skin which includes the base of the growth, always acts as a radical cure. If the base of the growth is large, it may be necessary to insert sutures to hold the edges of the skin in apposition. They should be removed as early as practicable.

Fig. 24.   Congenital Condyloma.

For the diagnosis and treatment of congenital lipoma, myoma, fibroma, osteoma and neuroma, the reader is referred to works on general surgery, as they are of rare occurrence in early life, and a description of them here, for that reason, omitted.

CHAPTER VII.

IMPERFECT CLOSURE OF EMBRYONIC OPENINGS—ANTERIOR.

Abdominal Hiatus—Exstrophy of the Bladder—Congenital Hernia.

HIATUS.

Abdominal hiatus is an opening in the abdominal wall through which more or less of the contents of the abdomen protrudes. It exists at birth and when present is usually in the umbilical region. The area of malformation may be very small, or the entire anterior abdominal wall may be absent. The organs protruding through the opening are covered with a thin and usually transparent membrane through which the bowels can be seen.

Abdominal hiatus is due to an arrested development in the mesoblast and epiblast, in their folding together in front, to inclose the intestinal cavity of the embryo.

At an early period the embryo curves or folds upon itself longitudinally and laterally, so as to be comparable to a canoe, with the bowl of the boat corresponding to the intestinal cavity. At this period the yolk-sac is partly within and partly without the cavity, communicating by the omphalo-mesenteric duct. It is the rudiment of this duct and sac that remains to enclose the organ, in abdominal hiatus. The contents are usually adherent to this membrane or sac.

Treatment. The treatment consists in returning the protruding organs into the abdominal cavity, removing the sac, and closing the hiatus with sutures. In some cases, where the edges cannot be readily brought together, a plastic operation may be attempted. Treatment is admissible only where the hiatus is very small and the adhering surfaces can

be easily separated. The author has met with several cases where a successful operation would have been an impossibility. Death took place about the fourth day.

Fig. 25. Abdominal hiatus in a monster.
(Burton, in Eclectic Medical Journal.)

EXSTROPHY.

Exstrophy of the bladder is a deformity where there is a deficiency of the anterior wall of the abdomen and bladder. At an early period in embryonic life, the epiblastic and mesoblastic tissues fail to come together normally in the median line, and exstrophy is the result. It is often associated with malformation of the genital organs and absence of the pubic arch.

In exstrophy the urine flows from the ureters in a normal manner, but because there is no anterior bladder wall it makes its escape externally.

The mucous membrane of the posterior surface of the

bladder protrudes, and becomes inflamed from contact with the clothing, giving it the appearance of an irregularly shaped ulcerating tumor, protruding from the abdominal wall, from the surface of which the urine is constantly oozing.

These unfortunates are great sufferers, not only because of the pain, from exposure of the delicate lining of the bladder, but also because of the stench from the constant dribbling of the urine.

Diagnosis. The diagnosis is apparent. The symptoms are not liable to be confounded with those of any other lesion.

Prognosis. A complete cure cannot be expected. If an anterior bladder wall can be secured, and the urine directed into a urinal, it will go a great way towards relieving the patient. A large percentage of the cases operated upon become exhausted and die as a result of the operation.

Treatment. Early treatment consists in careful attention to the parts so as to prevent excoriation as far as possible. During infancy the softest napkins should be used, and great care be taken as to cleanliness. Bathing with warm boric acid solution has both a soothing and healing effect on the sensitive surface. Borated cotton pads may be worn to advantage till an operation for relief can be performed.

Operative Treatment consists in a plastic operation for the purpose of supplying the deficient bladder wall; and also to provide a natural receptacle for the urine, or to conduct it into a urinal. The operation may be performed at any time before the child is old enough to go to school. It is always best to operate before the child is old enough to discover that it is not like other children, and to feel the shame attending this discovery.

The plastic operation will vary in nature and extent according to the size of the exstrophy, and the accompanying deformity. If the exstrophy is small it is a simple matter to cover it. If it is accompanied by a large inguinal hernia, or if the pubic bone is absent, together with marked epispadias, it will be very difficult to borrow flaps sufficient to make the repair.

In doing the operation, two skin surfaces must be used;

the one internally to form the lining or anterior bladder wall, and the other externally to form the skin covering. These two flaps rest with their raw surfaces together, being stitched at their margins, and shaped in such manner at their lower boundary that the urine will flow into the urethra, or into a urinal.
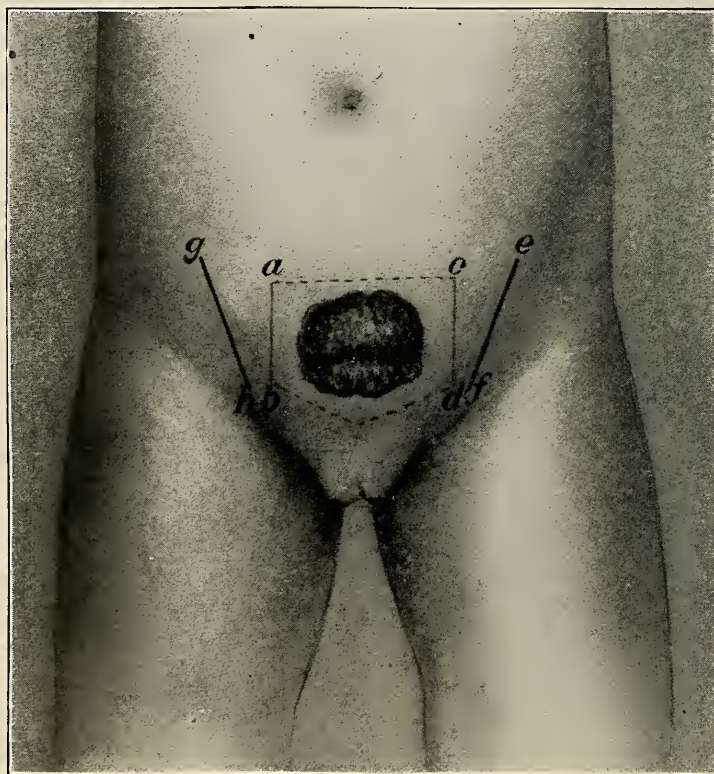
Fig. 26. Exstrophy of the bladder. Author's operation. Incision *a*, *b*, and *c*, *d*, to be brought together and sutured as in Fig. 27.

If the exstrophy is small and the skin movable, as is usually the case in young children, the operation may be performed by drawing a fold of skin from each side towards the median line, and freshening the flaps, and stitching by two rows of sutures in the middle; while above and below, incisions should be made so that the ends of the flaps are stitched to the abdominal layer.

In Fig. 26 and 27 the flaps *a, b,* and *c, d,* are pulled up and freshened and stitched; first *c, d,* and then *a, b;* then *a, c,* is stitched to the abdominal skin and also *b, d.*   The incision *e, f,* and *g, h,* drawn apart to relieve the tension.

The writer has had good results following this operation where rubber catheters were introduced into the ureters and
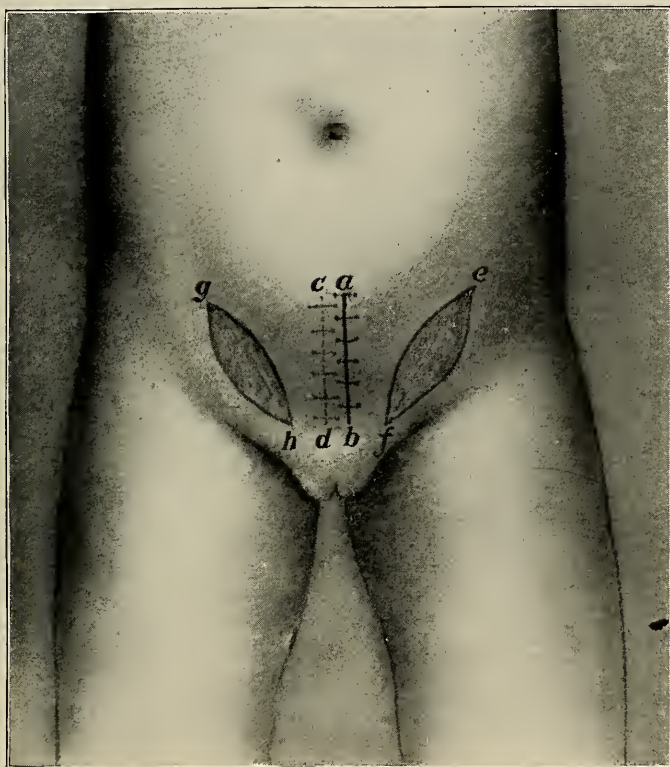
Fig. 27.   Exstrophy of the bladder.   Same as Fig. 26.   *e, f,* and *g, h,* drawn apart to allow the flaps to come together.

the urine drained off, so that it did not come in contact with the flaps until the catheters were removed on the fourth day.

Dr. A. J. Howe, in the Eclectic Medical Journal, January 1890, describes his operation as follows:

" Dissect flap (*a*) Fig. 28, to a base line indicated by dots; then dissect flap (*b*) to a base line presumed to be wide or broad

enough to embrace vascular supplies. Next proceed to close
the gaps made by displacement of the flaps. In doing this
employ wire sutures, three or four, which reach beyond the
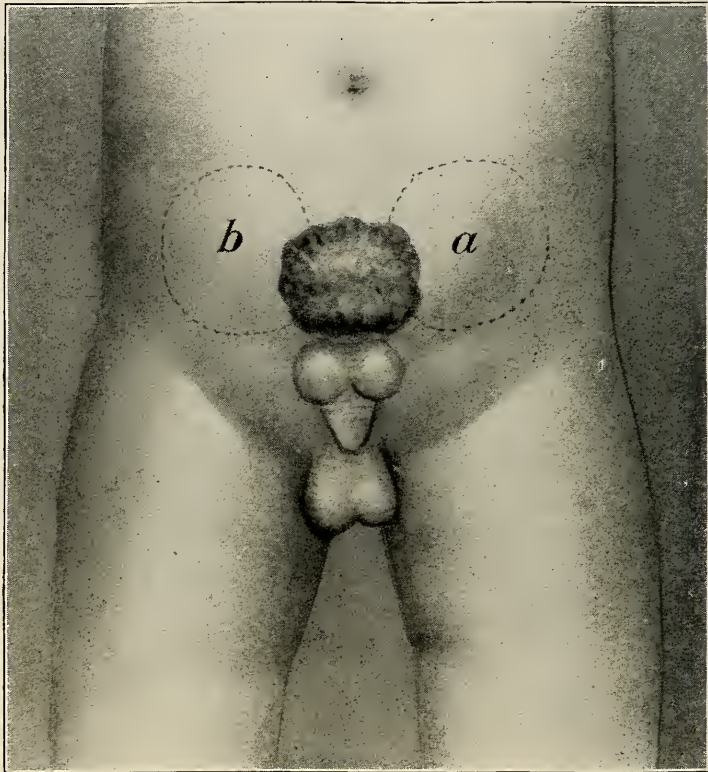
Fig. 28.   Exstrophy of the bladder, *a*, to be turned upon itself, so that
the skin forms the anterior bladder wall, *b*, to be slid over it for
the outer covering.

chasms and beyond the edges to be drawn together. This
part of the work having been well done on both sides the ad-
justing of the flaps is next in order.

"Flap (*a*) is turned upside down, its base acting as a
hinge. Catgut sutures served to fasten it to the raw surface
on the opposite side of the exstrophy. Then flap (*b*) is swung
on its base and made to cover (*a*)—raw surface to raw
surface. Finally, carefully suture the border of the upper

flap to the raw surface of the chasm with silk worm gut sutures close together. Plenty of dressings are applied and held in place in the usual manner."

The webbed penis is to be repaired at a future operation.
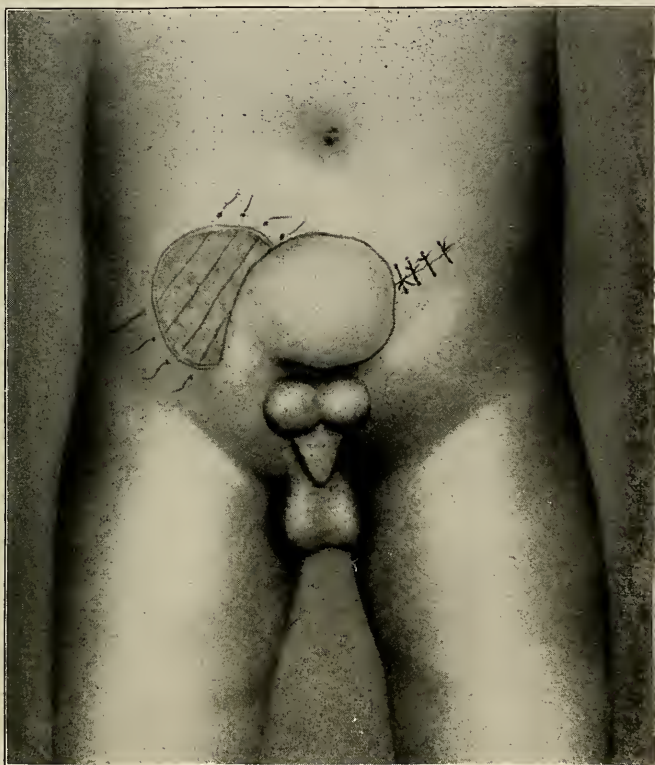
Fig. 29.   Operation for exstrophy, showing the outer flap turned in position.   Sutures inserted to close the chasms.

Hernia.

Congenital hernia is a protrusion of any viscus through the abdominal wall. Its occurrence is usually either at the umbilicus or through the inguinal canal. These two places become anatomical weak points, because of the fact that during the process of embryonic development, as the lateral structures come together and inclose the abdominal cavity,

there must be an allowance made for the passage of certain natural structures.

In the umbilical region, the umbilical cord passes, while the testicles and spermatic cord in the male, and the round ligament in the female, passes through the inguinal canal.

From an embryological standpoint, the structures which are involved in congenital hernia, are the abnormally protruding organs or invaginated parts which are derived from the hypoblast; and the parts through which the invagination occurs, which are derived from the mesoblast, while the tissues derived from the epiblast or the skin is not involved. A deficient activity in the development of the mesoblast in these situations, results in an opening through which the viscera protrudes. The viscera always carries with it its covering the peritoneum, which protrudes through the muscles, and rests against the fascia and skin.

(For treatment the reader is referred to Section IX.)

CHAPTER VIII.

IMPERFECT CLOSURE OF DORSAL EMBRYONIC OPENINGS.

General Etiology—Spina Bifida—Meningocele—Encephalocele—Anencephalus
—Hydrocephalus.

At a very early stage in embryonic development the neural canal as well as the visceral, remains open. The neural, or dorsal canal, is the first to close. The arches of the vertebræ together with the other adjacent mesoblastic tissues, which form behind to complete the enclosure of the spinal canal, should be completed in the third month. At about the same period the epiblastic covering, or the epidermis, is formed.

A deficient or irregular development of the mesoblast, or of both mesoblast and epiblast on the dorsum of the embryo, is followed by defective openings in the bones, or of both bones and epidermis, which enclose the cavity of the cranium and the spinal canal.

The structures derived from the hypoblast develop within the cranial cavity and spinal canal, into the brain and cord, together with its envelopes or membranes.

Deficient or irregular development of the structures above described furnishes a variety of malformations of the head and spine. The degree of the malformation, or its extent and severity, depends largely upon the extent of the gap caused by the defect; as through this gap the underlying structures protrude.

There are cases on record (Human Monstrosities, Part II), where the failure of development was very extensive in the hypoblast; being manifested by an entire absence of the brain and spinal cord, as well as a deficiency in the arches of the vertebræ and the skin. The neural canal was left wide open

like a trough extending from the frontal region to the sacrum.

Generally speaking, the gap exists as an opening over a small portion of the brain or spinal cord, thus allowing these important structures or their membranes, to protrude. The most common of these malformations is that of spina bifida.

Fig. 30.   Anencephalus.   Absence of brain and cord.   Entire deficiency of the structures necessary to close the dorsal embryonic opening.

Spina Bifida.

Spina Bifida is a protrusion of more or less of the contents of the spinal canal through a congenital cleft in the bones and muscles. It may be so small as to be scarcely noticeable; or, as large as an infant's head. Its usual location is in the lumbar region, but it may occur at any place along the spine. It is noticed at, or shortly after birth, and has a tendency to increase somewhat in size. The bodies of the vertebræ in the situation of the spina bifida are normal, but the spinous processes, with more or less of their laminæ, are absent. The

defect usually involves two or three vertebræ, but in this there is a variation. The opening in the bones is sometimes narrow, and again nearly as wide as the spinal canal.

The protrusion or enlargement, is composed of the membranes of the spinal cord, blended together and acted upon by the pressure of the cerebro-spinal fluid. Under this pressure it assumes the form of a sac, with its neck at the opening in the spinal canal, bulging out under the skin. The

Fig. 31. Side view of Fig. 30.
(Burton, in Eclectic Medical Journal.)

fluid in the sac usually communicates with the cavity of the spinal canal and the cranium. Pressure upon the spina bifida will sometimes produce stupor by increasing the pressure within the cranium.

The spinal cord or its continuation usually occupies the normal situation in the spinal canal; however, in some cases, it protrudes, and is contained within the fluid in the sac, while in others, it may be spread out and adhere to the

sac wall. In most cases there are numerous spinal nerves floating in the fluid and adhering more or less to the sac.

Fig. 32. Cyclo-Pseudencephalus, with encephalocele and spina bifida. (Stevens.)

Spina bifida is often associated with other deformities, such as hydrocephalus, or paralysis of the lower part of the body; talipes equino-varus, etc.

Diagnosis. The diagnosis can be made by observing that the tumor is congenital, always in the median line, and protruding through the underlying bone. The defect in the bone can be felt by pressing the enlargement to one side. The tumor is oval, elastic and fluctuating. It is made more tense by the child straining or crying. Gentle pressure upon the tumor, or raising the pelvis above the head, causes the tumor to diminish in size and may produce pain and spasm.

Differential diagnosis should be made between spina bifida and cystic tumors in the region of the spine. This can usually be done by observing the absence of any spinal or brain symptoms, and by there being no opening in the bone in connection with the cyst. If there is still any doubt remaining as to the diagnosis, or differential diagnosis, an examination should be made by means of the Roentgen ray, as with it the contents of the tumor can be plainly seen.

Prognosis. The tendency in spina bifida is towards meningitis and rupture of the sac; and as a result death usually takes place.

Where the protrusion is small, a spontaneous cure may be effected, but as a rule there is a gradual enlargement. Some cases reach middle life. Generally speaking the outlook is not encouraging, as in the most favorable cases the child is small, poorly nourished and subject to diseases which seriously complicate the existing condition.

Treatment. If the protrusion is small, covered with sound skin and not growing rapidly, an attempt should be made to induce a cure by gentle and constant pressure. This can best be accomplished by covering the tumor with a soft wool padding and applying a bandage. A rubber elastic bandage can be used to good advantage. Cotton and collodion may be used. If this treatment is begun early and persisted in, it may effect a cure.

By way of operative treatment, that of excision gives the most satisfactory results. Under the most strict aseptic and antiseptic precautions the tumor is to be opened, the fluid allowed to escape slowly, the redundant skin, the membrane forming the sac and the superfluous nerve tissue care-

fully dissected away; the cord or cauda equina replaced in
its normal situation; the dura carefully stitched with strong
catgut; [the muscles and skin brought together separately,
and stitched after the same manner as in a hernia operation.

Antiseptic dressings and padding should be applied and
held in position by a rubber elastic bandage, producing gentle
pressure over the wound, and the child kept very quiet, lying
on its side until the healing is complete. After the operation,
moderate pressure should be kept up to prevent a secondary
protrusion.

Many operators have tried to close the opening in the bones
by transplanting bone plates within the gap from adjacent
bones or from animals; but, as yet, the operation has not been
sufficiently successful to warrant us in recommending the
procedure.

Operative treatment, such as tapping, injection of the
cavity with the tincture of iodine, draining by open incision,
or seton, has been practiced but with greater danger of
secondary meningitis, than the operation of excision described
above.

MENINGOCELE.

Meningocele is a protrusion of the membranes of the brain
through an opening in the skull. The term meningocele is
also applied to spina bifida. The membranes usually pro-
trude through the opening at the posterior fontanelle, but this
may occur at any of the sinuses or openings in the cranium.
There is usually a defect in the formation of the bones, so
that the opening is much larger than is natural; and through
it the dura protrudes forming the enlargement. It may either
be under the scalp, or, where the development of the scalp
is defective, that the *dura* forms the external covering.

Diagnosis. The diagnosis is easy, from the fact that there
is no bony surface underneath the fluctuating enlargement.

Prognosis. The prognosis is favorable where the protrusion
is slight. As the child grows, there is a natural tendency
toward the reabsorption of excessive cerebro-spinal fluid. In

some cases, when ossification is completed, the opening becomes nearly closed. In extreme cases the prognosis is bad, as the membranes are liable to rupture and expose the brain to infection.

Treatment. Treatment must be pursued on the conservative plan. Pressure cannot be used, because the impulse of the pressure is communicated directly to the brain from which serious symptoms might arise. The head of the child should be kept well elevated. Careful attention to all the functions of the body, and due precautions as to the proper sanitation, are the essential features to be looked after.

If a rupture is liable to take place, an effort should be made to remove the sac by an operation similar to that of excision for spina bifida.

Encephalocele.

Encephalocele is a hernia of the brain, together with the membranes, through the skull. It occurs usually through the median line; and, like spina bifida, is due to a defective development of the bones. It is usually an oval tumor-like mass protruding under the scalp. In shape and size it varies. In one case the encephalocele consisted of the entire brain. (Ref. Hand Book of Medical Sciences, Vol. vii.)

Diagnosis. The diagnosis is made by determining the presence of fluid by percussing the tumor with the child in different positions. Usually the enlargement is somewhat irregular and the brain substance can be felt.

Prognosis. The prognosis is not favorable.

Treatment. There is very little that may be done for encephalocele excepting on general principles. Operations have been performed, and the protruding brain removed, but with no degree of success.

Anencephalus.

Anencephalus is absence of the brain and, usually, of the spinal cord as well. These cases rarely occur as a single

malformation, as a defective development of this character is
most likely be attended by a corresponding deficiency in all
the structures of the cranium if not those of the spine.

Fig. 33.   Anencephalus.—Stillborn.

Fig. 34.   Side view of Fig. 33.

Anencephalus is the most conspicuous example of the
failure of embryonic development to form the dorsal or

neural canal. These cases are usually still-born; if not, they die shortly after birth.

HYDROCEPHALUS.

Hydrocephalus is an abnormally large amount of fluid in the cranium. The cranial bones are usually separated at their sutures so that the fluid presses them apart causing the head to be enlarged in quite a symmetrical manner. The fluid is cerebro-spinal in character and may be very exces-

Fig. 35. Hydrocephalus with a small meningocele.

sive in quantity. It may either increase or diminish after birth. The location of the fluid is usually in the subarachnoid space (hydrocephalus externus); in some cases it is in the dilated ventricles (hydrocephalus internus); in others the brain may be arrested in development to such an extent that the hemispheres form great sacs, and the fluid occupies all the intracranial spaces.

A hydrocephalic head has quite a distinctive appearance. The scalp seems stretched, and is marked by numerous enlarged veins. There is a resulting disproportion between the enlarged head and the small face.

Children with congenital hydrocephalus usually appear bright, but as age advances they are liable to be deficient in some mental characteristic.

Diagnosis. The diagnosis is very plain.

Prognosis. The prognosis is unfavorable as they are usually subject to spasm and die early. Occasionally a case will improve and reach adult life.

Fig. 36. Same as Fig. 35. Circumference of head at birth, 23 inches; at two months, 24 inches; at five months, 21¾ inches.

Treatment. The treatment consists in keeping the head elevated and keeping up an excellent degree of health for the child by the administration of tonics, and attention to nourishment and to the sanitary conditions. If consistant, the bowels should be kept free and the kidneys active, to relieve the pressure of fluids as far as possible.

Operative treatment, such as aspiration, permanent drainage and compression offers little or no prospect of success.

CHAPTER IX.

IMPERFECT FORMATION OF NATURAL OPENINGS.

Harelip—Cleft-Palate.

HARELIP.

Harelip, is a cleft upper lip, and is due to an arrested development. The cleft may be *single* and a little to one side of the median line, or it may be *double*—one on each side of the median line. Harelip is said to be *complete* when the cleft involves the soft parts and the bone, so that the opening of the mouth communicates with that of the nose, and may be either single or double.

In cases of double complete harelip, the portion between the clefts, or the central segment, as it is called, hangs from the vomer.

Harelip is *incomplete* where the cleft does not involve the nose. It may vary in extent from that of a superficial notch in the border of the lip to a cleft, that reaches the nostril. Incomplete harelip is usually single, although in this, it may vary. There are numerous examples of double harelip where it is complete on one side and incomplete on the other. Complete harelip is usually associated with cleft palate, while the incomplete form, as a rule is not.

The occurrence of malformations of the face can best be understood by giving their developement a brief consideration.

At a very early period in the existence of the human embryo, its cephalic extremity presents on its anterior surface a large opening which communicates with the alimentary canal. Around this opening are numerous clefts, and between them are processes which, by embryonic tissue proliferation,

develop to form the face. In the lower part there are the four branchial arches, the processes to form the uppermost one uniting in the median line to give rise to the lower lip and lower jaw.

The ends of the two maxillary processes (superior) do not unite, but have projecting down between them, a broad plate, the fronto-nasal process, from which is developed the nose. The central portion of the fronto-nasal-process, called the mid-frontal process, pushes still farther downward and from it are

Fig. 37.   Single harelip, complete.

formed the incisive portion of the superior maxillary, and the *lunula* or central part of the upper lip. The maxillary processes on either side unite with the frontal processes and complete the formation of the superior maxillary bone and upper lip, together with that portion of the face just above.

These processes are all derived from the mesoblast; and, at about the eighth week of embryonic development of the face and jaws, should be completed. At this time they are covered with a layer of epiblast. Errors in the process of cell proliferation and the coalescence of these processes, give rise to fissures and clefts in the structures derived from them.

Chief among these deformities is that of harelip, which is

due to an arrested development and failure of union between the mid-fronto-nasal process and the maxillary processes.

Treatment. The only treatment is that of repairing the defect by operation. The *time to operate* is as soon after birth as possible. If the repair is made immediately after birth, the healing process is nearly completed by the time the infant begins to nurse. The operation can be done at this time without an anæsthetic and without the disagreeable strangulation from the blood, as is usually the case under anæsthesia.

Fig. 38. Same case as Fig. 37, after operation. (L. E. Herrick.)

If the case is double or complete harelip, the child can not nurse until the repair is made; and, in addition, the cleft in the bone will be much compressed by early operation, while the bones are yet soft.

Operation. If the operation be done immediately after birth, an assistant should hold the infant in a semi-sitting posture. The operator is able to proceed with rapidity, often making the repair in a few minutes.

Great care should be always exercised against the unnecessary loss of blood. This is best done by having another assistant compress the coronary arteries with his fingers or

compression forceps. If an anæsthetic is used, the head of the child should be turned to one side and the throat kept clear of mucous and blood, so that respiration shall be free.

In simple cases, the repair can be made by paring the bor-
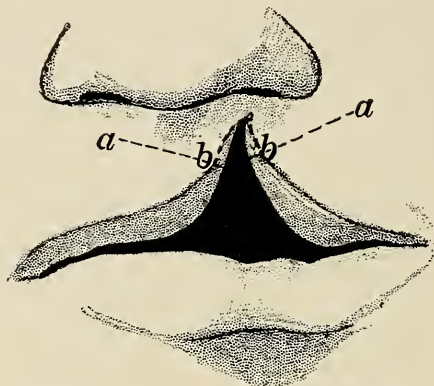
Fig. 39.   Single harelip, incomplete.   Lines *a-b* mark the position of the incisions.   The line *b-b* the denuded portion.
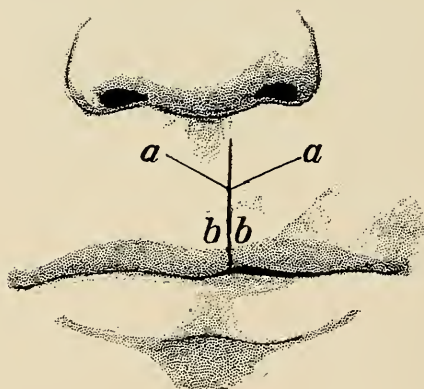
Fig. 40.   Single harelip drawn together after the incision made as in Fig. 39.

ders of the cleft and bringing the parts together, always bearing in mind that the lip should be approximated evenly and without much tension, so that healing may be by first intention. The tension is greatly relieved by separating the lip from the underlying bony structures.

Harelip pins and a figure-of-eight suture may be used to secure the parts. The pins are introduced about one-quarter of an inch from the margin of the cleft, passing to the edge of the cleft on the under side and through the opposite flap in the same manner.

After the parts are brought together as above, intermediate sutures of catgut or silkworm gut may be used to still further co-apt the parts. Silkworm gut may be used without the pins. The wound is best dressed with iodoform, held with a cotton and collodion dressing, which should pass well
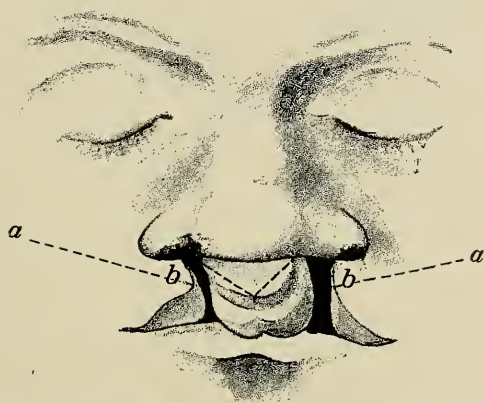
Fig. 41. Double complete harelip. Lines *a–b* to indicate the incision; the dotted v-shaped line indicates the denuded portion of the middle segment.

around on the cheeks. The dressing and the pins should be removed on the third day and the collodion dressing re-applied; and, if necessary, a piece of adhesive plaster applied from one cheek to the other, to relieve tension.

In some cases, when the cleft is complete, either single or double, the intermaxillary portion of bone is very much in the way of making the repair in the soft parts. In such cases it may be necessary to produce of it a green-stick fracture, thus forcing it back into a more natural position. In other cases it may protrude so far, or, perhaps, protrude from the nose, so that it would be impossible to replace it; then it is best to remove it entirely. If there is a portion of lip or skin on the bone of the intermaxillary segment it can well be utilized in the repair of the lip.

In cases where the soft tissue is scant, some difficulty is experienced in making the repair. It is best accomplished as follows: After the lip has been well separated from the underlying bone, an incision is begun at the prolabial border, or, where the red border of the lip ends, and running backward and upward, it passes the angle of the nose extending toward the malar process. A similar incision is made on the opposite side.
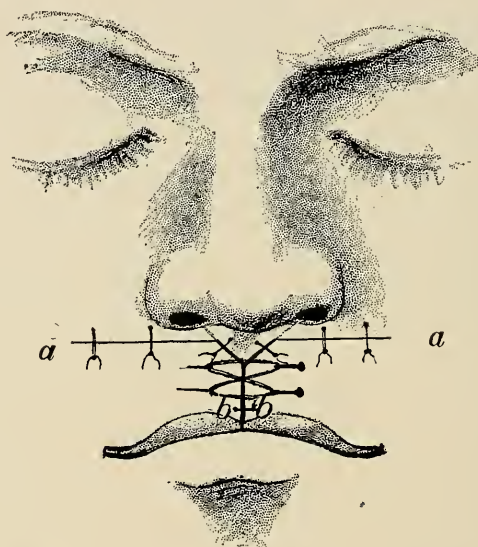
Fig. 42.   Double complete harelip drawn together and held by harelip pins and sutures.

If the case is double, and there is a central segment of the lip, it should be shaped into a V. Then the parts are to be drawn together far enough to make a sufficiently long upper lip. The writer has used this operation in many cases with great satisfaction. It offers a facility for shaping the nose, which, in some cases, is either flattened or drawn, as well as that of making an abundant and well formed lip without undue tension.

CLEFT-PALATE.

Cleft-palate is a longitudinal opening in the roof of the mouth, and is due to a failure of the embryonic structures to reach the proper development. In the latter part of the eighth week of embryonic life the palatal processes are formed by an extension of the inner sides of the alveolar arch. These coalesce and complete the formation of the palate, while a defect in the process results in cleft-palate. Through this cleft, the cavity of the mouth communicates unnaturally with the nares. The cleft is in the median line, and may consist of a notch in the soft palate, or vary in extent to a cleft completely through the hard palate and superior maxillary to the cavity of the nose. When complete, it is associated with harelip. The cleft usually consists of a fissure, but the opening may be of considerable size, even to the entire absence of both hard and soft palates; indeed, the variation is so marked that the surgeon scarcely sees two cases that are exactly alike.

When cleft-palate is marked, it gives rise to serious trouble. The infant is unable to nurse because the suction from the tongue against the roof of the mouth is interfered with. The food being taken into the mouth is pressed upon by the tongue and passing into the nares, runs out of the nostrils more readily than down the throat.

Unless the infant is fed very carefully with a spoon so that the food can run down into the throat, it soon becomes weak from lack of nourishment and dies. As the child learns to talk, his articulation is so indistinct that he is scarcely understood. The sounds pass through the nose.

Treatment. The treatment should be instituted as early as possible, for the reason that if successful, the difficulties above alluded to are immediately overcome. The older the child grows and the more accustomed he becomes to talking with the defect, the more difficult it is for him to overcome the impediment in his speech after the defect has been removed.

Many of these cases are relieved with such difficulty that it is best to allow them to reach the age of three or

four years, when ossification and dentition are nearly completed, before resorting to active treatment.

Should cleft-palate be associated with harelip, an early operation should be done on the lip; and, if necessary, on the bone, so that the tension of the lip across the face will have a tendency to still further approximate the edges of the cleft in the bone. In some cases artificial apparatus may be used
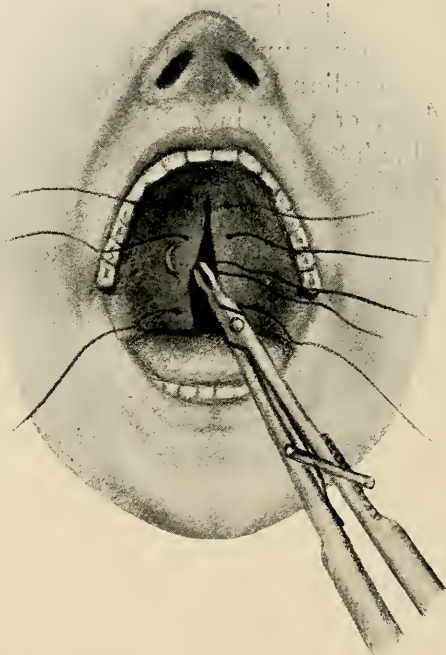
Fig. 43.   Cleft-palate, incomplete, showing the method of introducing the sutures after the edges have been denuded.

to gradually bring the bones more closely together, thus narrowing the cleft.

The writer has on a number of occasions, when the first operation was done, removed all or part of the intermaxillary portion of bone, so that there might be no bony prominences to prevent the cleft-palate coming together evenly.

There is a class of cases in which there is such deficiency of palate bone, and where the alveolar arch is com-

plete, that it is impossible to narrow the cleft to any appreciable extent. These cases with such large openings, had better be referred to a dentist for an artificial plate to close the opening. The soft parts in the roof of the mouth have been repaired in these cases and have broken open again, because of no underlying bone for support.

Staphylorrhaphy, or the operation for the closure of a cleft-palate is done under anæsthesia. The head should be turned to one side, with a mouth-gag placed between the teeth. The freshening of the margins of the cleft is done with forceps and
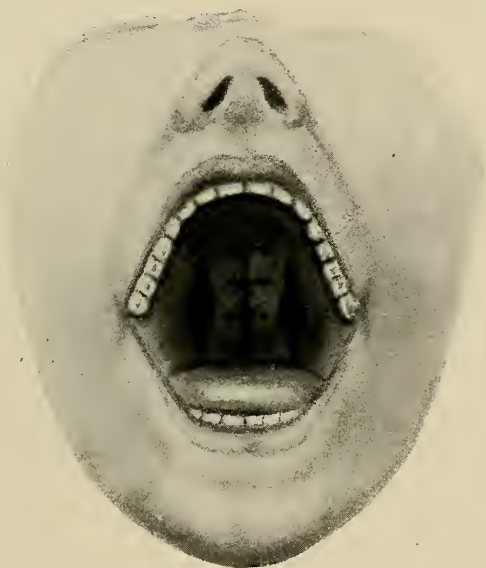
Fig. 44. Cleft-palate, incomplete, repaired. The openings on either side made to relieve tension.

a narrow-bladed knife, especial care being exercised to keep the child's throat clear of blood.

If the freshened surfaces come together readily, the sutures may be inserted; if not, the soft tissues should be separated from the bone so that there will be no tension on the sutures. This can best be done with a knife that is angular or curved on the flat, so that it can be readily passed between the soft tissues and the hard palate, the soft parts being loosened on each side of the cleft.

If their dissection does not allow the flaps to meet readily, a *longitudinal incision* can be made on each side of the cleft; care being exercised not to cut the palatine arteries. Through this same incision the levator and tensor palati muscles can be divided by pushing the knife through posteriorly, should it be thought necessary.

Silkworm gut sutures should be inserted one-fourth of an inch apart and tied, not too tightly. The sutures can best be introduced with curved cervical needles in a needle-holder, or a sharp aneurysm needle. The parts, should then be well dried and painted over with a solution of iodoform in collodion.
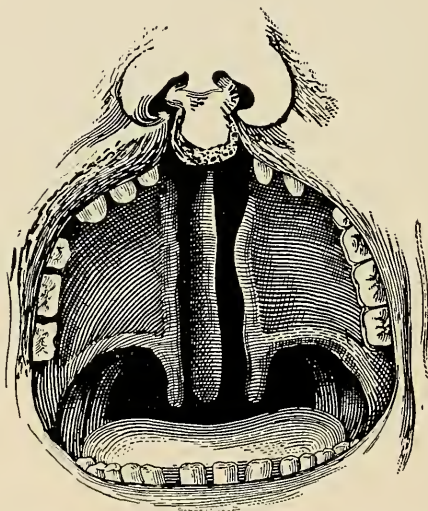
Fig. 45. Double complete harelip and cleft-palate.

The sutures should be removed on the eighth day. If any small openings remain, they can be stimulated to promote the healing process by being touched with the cautery. The patient should be kept on liquid diet for two weeks after the operation.

Osteoplasty, for cleft-palate, as advocated by Dr. Brophy, may be applicable in a certain number of cases. This method can best be performed at the same time as the operation for the closure of the harelip—shortly after birth, and

consists of forcibly bringing the bones together and securing them with wire sutures, passed through from the outside of the alveolar arches and above the palate bones. These sutures can be readily introduced, and the wire twisted over lead buttons, through the incisions at the time of the early operation.
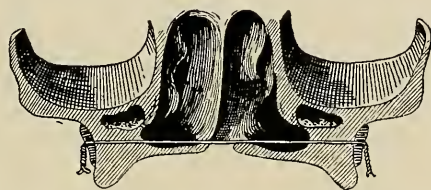
Fig. 46.   Cross section of complete cleft-palate, repaired after Brophy's method.

Where this method can be used, it offers the advantage of having the defect in the palate repaired early, and at the same time as the harelip is done, making one operation for both harelip and cleft-palate.

CHAPTER X.

EPISPADIAS.

Epispadias is a division, more or less, of the upper wall of the urethra. *Complete epispadias* is where the division involves the spongy portion and skin of the penis, and is complete throughout its whole extent. *Incomplete epispadias,* may exist as an opening on the upper wall of the penis, through which the urine passes.

Epispadias is often associated with exstrophy of the bladder, in which case there is usually some defect in the formation of the pubic arch and the epispadias is complete.

Between the third and fourth month in the development of the embryo, the external genitals in the male are formed by the closure of the genital furrow, which takes place from both sides. When there has been a deficiency in the folding together of the mesoblast and epiblast above, as in exstrophy, the upper borders of the genital furrow are held apart and nature, through her efforts to close the furrow, closes it below, thus leaving the cleft in the upper wall of the penis, or complete epispadias.

Incomplete epispadias is due to error in the development of the genital tubercle into the penis, and a displacement of the meatus urinarius upwards and backwards. An unequal formation in the processes of the external genital tubercle will give this result.

Where epispadias co-exists with exstrophy, the penis is rudimentary, being very short and broad. In some cases it

is turned upward and acts as a valve to assist in holding the urine.

In complete epispadias the corpora cavernosum and glans penis are divided through the middle and spread apart, giving rise to an intermediate groove. The rudimentary prepuce hangs as a wide flat piece of skin underneath. There is usually incontinence of urine in these cases.

In incomplete epispadias, the meatus may exist at any point on the dorsum, and the groove may extend from the unnatural meatus to the end of the penis. In these cases, much annoyance is experienced in urinating by the scattering of the stream. In all cases there is much irritation from the urine and many times the reflex excitation is marked. Sexual desire is present, but cohabitation is difficult.

Diagnosis. The diagnosis of epispadias is plain, and bearing in mind the description, the condition or the deformity is recognized at once.

Prognosis. The prognosis depends upon the available means by which plastic surgical operations may be performed, to make as nearly as possible a normal urethra, as well as a penis of moderate size and shape.

Treatment. Unless there is some interference with the necessary functions of life, it is well to let the child pass the first three years before the severe operative procedure is begun; however, the operation may be performed at an earlier date. A cure should be effected before the child begins to go to school, as at that time his companions will annoy him by unkind remarks, and he soon is aware of his misfortune and becomes morbid and unhappy. He begins to seek his own company, and from the local excitation soon becomes addicted to depraved habits. The *age of from three to six years* is usually selected for these operations.

Early in life it is well to divide any restraining bands or adhesions, to facilitate the development and straightening of the penis; but a redundant prepuce should not be sacrificed, as it might be needed for flaps at a future operation.

If exstrophy is present it should receive treatment first, as an attempt to repair exstrophy and epispadias at one time might be too great a tax on the patient's strength.

Catheterization should be maintained throughout the healing process if possible, so as to keep the urine away from the cut surface. Many operators prefer to make two operations for the epispadias; first, to close the groove in the penis; and, second, an operation to close the opening in the upper end of the groove. This procedure is advisable where there is a scantiness of tissue; but where the parts will permit, it is well to close the urethral canal over a catheter at one operation.

Operation, If the groove from the epispadiac opening to the end of the penis is of sufficient depth to retain a catheter while the corpora cavernosum is drawn together over it, pro-
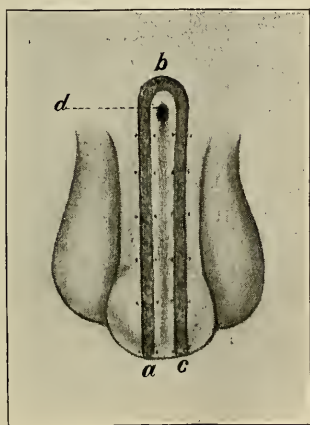
Fig 47. Epispadias operation. The surface, *a-b-c*, is denuded. *d* is the opening of the urethra.
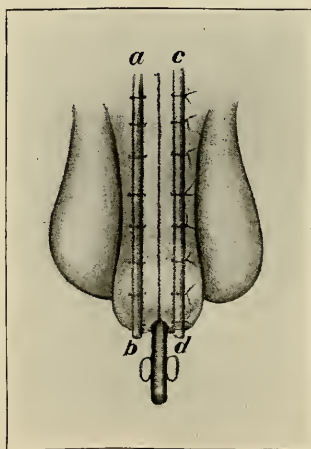
Fig. 48. Epispadias operation completed. *a-b* and *c-d* quills to prevent sutures from cutting.

ceed to denude a portion on each side of the groove as represented in Figs. 47, *a*, *b*, *c*. If the groove is too shallow for the catheter make an incision in the bottom to deepen it as much as may be necessary.

After the parts which are to be united have been well denuded, the catheter is inserted and the sutures are introduced and passed through the tissues on either side, and the parts drawn together as represented in Fig. 48. The drawing or cut-

ting of the sutures is prevented by quills on each side of the closed wound, Figs. 48, *a, b*, and *c, d*. The urine is conducted away through the retained catheter until about the fifth day after the operation, when sutures and catheter can be removed and the patient allowed to urinate at will.

HYPOSPADIAS.

Hypospadias is a deficiency in the lower urethral wall, so that the urine escapes abnormally at some point between the extremity of the glans penis and the perineum. The location of the deficiency and the urethral opening, along the course of the urethra has given rise to names indicating its situation. *Balanic hypospadias* is the name given where the deficiency is in the glans penis, or the deficiency may be *penile, scrotal* or *perineal*. The deficiency depends upon the degree of the arrested development.

The embryonic development of the external organs of generation, both male and female, is from the genital tubercle, which appears in the sixth week. Around the genital tubercle is soon formed the genital folds, and towards the end of the second month the tubercle presents, on its lower aspect, a groove—the genital furrow. All these parts are well developed by the second month, yet no distinction of sex is possible. The female organs are developed from the above by an easy transition, while in the male the changes are greater. The genital tubercle is gradually developed into the penis, it being completed in the fourth month.

The genital furrow, as the tubercle develops into the penis, elongates on its under surface, throughout nearly its whole extent, but afterwards closes to form the lower wall of the urethra, and the genital folds come together below to form the scrotum, all about the same stage, namely; between the third and fourth month. A failure of proper proliferation of cells of the genital tubercle gives rise to a dwarfed penis, while a failure of the genital furrow to close naturally, will give rise to hypospadias. The genital furrow may fail to close throughout its whole extent, leaving the opening of the urethra

in the bottom of a cleft in the perineum, the scrotum divided, and the penis dwarfed; a condition very closely resembling the external genital organs of the female.

The resemblance is so close that at birth it is quite easy for the attendants to be mistaken as to the sex of the infant. It may be judged a girl instead of a boy. Even physicians have been known to mistake a hypospadiac for a female.

The natural closure of the genital furrow is from the perineum forward, and the arrested development is quite apt to be the most frequent in the parts that are the latest in their formation. This is the case where the hypospadial opening is near the glans penis. The penis is sharply curved upon itself toward the opening, and a groove marks the under surface of the glans as the imperfect tract of the urethra.

Openings of this kind are serious from the fact of their interference with proper urination, and the inability to accomplish copulation and fecundation. During erection the glans is sharply bent down over the mouth of the opening, the penis is often dwarfed, twisted, bifid, flattened, or concealed under a rudimentary prepuce, or within integumentary folds resembling labia.

The urine as it is voided, is scattered and comes in contact with the skin, and local irritation and inflammation is the result. If the hypospadial opening is perineal, urination is performed by the patient squatting down, like a woman, to prevent wetting his clothing.

Diagnosis. The diagnosis of hypospadias is not difficult. After examination it is only necessary to note the manner of urinating in order for the attending physician to determine its nature.

An interesting feature in connection with perineal hypospadias is the determination of sex. Often these cases are judged wrongly at birth, and a time comes later in life, when it is necessary to make an examination that the proper sex may be determined and the mistake rectified. It is usually an oversight on the part of the physician. A close examination by him, at the time of birth, would have revealed the true nature of the case.

If there is any doubt as regards diagnosis, an examination of the internal organs of generation should be made. With a sound passed into the bladder and the index finger inserted in the rectum, the presence or absence of either uterus or prostate can be determined.

Prognosis. In hypospadias, the patient is usually able to pass urine without difficulty, excepting that the urine produces a smarting and burning of the irritated skin as it comes in contact with it.

These cases are somewhat grave, however, because of the mental and moral situation which attends them. Hypospadiacs are prone to all vices, and frequently suffer from protracted venereal diseases. The deformity seems to excite a local irritation that contributes to this. Copulation and fecundation in these cases are difficult.

Treatment. The cure depends upon operative treatment, and it should be performed during childhood. In order to facilitate the proper growth of the penis, the adherent prepuce and any other adherent bands, should be stripped back from the glans early in life.

Many operators make three separate operations to close a hypospadias; first, to straighten the penis; second, to form a urethral canal; third, to close the hypospadiac opening.

Cases differ so much in character that it is difficult to lay down rules that will apply to all. Straightening should be done at various times in early life as the penis is developing. If it is possible to complete the remainder of the repair at one operation, it is better than to make several operations of it.

The chief difficulty is from the annoyance of the urine. This is overcome by introducing into the bladder a metal catheter, and retaining it there throughout the operation, and for some days afterward, until the healing is complete. The urine is to be conducted into a receptacle by rubber tubing, thus keeping it from contact with the parts.

In some cases it is necessary to deepen the urethral groove in order that the flaps may cover the catheter without tension. This is done by making a longitudinal incision in the bottom of the groove. The catheter is then covered by

making two skin flaps; the first on one side of the catheter so that it can be reversed with the integument toward the instrument and stitched over to the other side; second, a flap is to be raised from the skin on the other side and stretched over the first flap, and stitched, the two flaps having their raw surfaces together.

Flap *a*, *b*, is reversed and sutured to the margin where *c*, *d*, is raised; then *c*, *d*, is pulled across and stitched to the
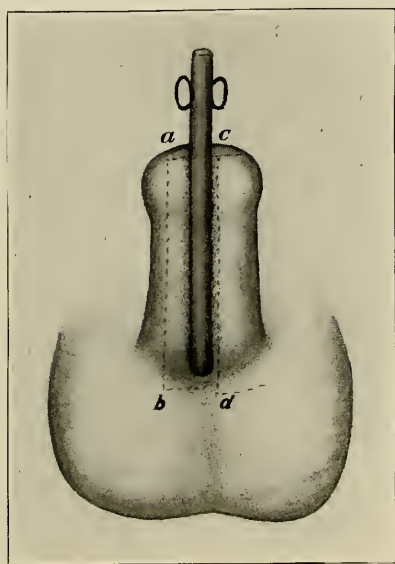
Fig. 49. Hypospadias operation. Two skin flaps, *a*, *b*, are to be reversed and sutured to the line *c*-*d*. Then the flap, *c*-*d*, is to be raised and sutured to the line *a*-*b*.

line *a*, *b*. Silkworm gut sutures are used one-fourth of an inch apart.

If the hypospadias is that of a *fistula* with the urethral canal continuing beyond it, the operation is done in the same manner, shaping the flaps to close the fistula.

Restlessness and erections, must be controlled by administering morphia, bromides, camphor or lupuline.

The sutures are to be removed on the fourth or fifth day,

and twenty-four hours later, the catheter can be removed. The parts should be kept bandaged to prevent dilatation of the newly formed canal, at least for a few weeks after the operation. Subsequent contractions of the urethra are to be overcome by the passing of sounds.

In severe cases of hypospadias, or those simulating hermaphrodism with perineal openings, cleft scrotum and dwarfed penis, great dexterity on the part of the surgeon is called for, in order to make the necessary repairs. A careful study of each case must be made, as plastic surgery may be able to place the parts in such a condition that subsequent marriage will be possible.

Even though the penis is very diminutive, it may be well to construct a urethra along its under surface. In many cases the skin from a redundent foreskin, or from the scrotum may be utilized in the flaps.

HERMAPHRODISM.

A hermaphodite is an individual whose genital organs either occasion an uncertainty in regard to sex, or give the impression that certain organs of both sexes are present.

True hermaphrodism, that is, an individual possessing both male and female genital organs with normal functions, is a condition that never exists.

Spurious hermaphrodism is a resemblance to the opposite sex and is not uncommon. In some cases the sexual conformation is very puzzling, especially when the presence of certain organs apparently belonging to the opposite sex are observed.

A male child with an undescended testicle, a cleft scrotum and a diminutive penis, certainly bears a close resemblance to a female, while the female child with atresia vagina and elongated clitoris, bears a close resemblance to a perineal hypospadiac male.

The absence of a visible penis is usually sufficient evidence with the laity to warrant the christening of an infant as a female, and the true sex remains undis-

covered until adult life is reached. Masculine traits predominating, a physician is called and an examination demonstrates that the supposed female is a male.

Many of the older writers reported cases as possessing two sets of genital organs; and even at the present time we occasionally hear of individuals possessing characteristics of both sexes. We have found, however, that one is easily de-
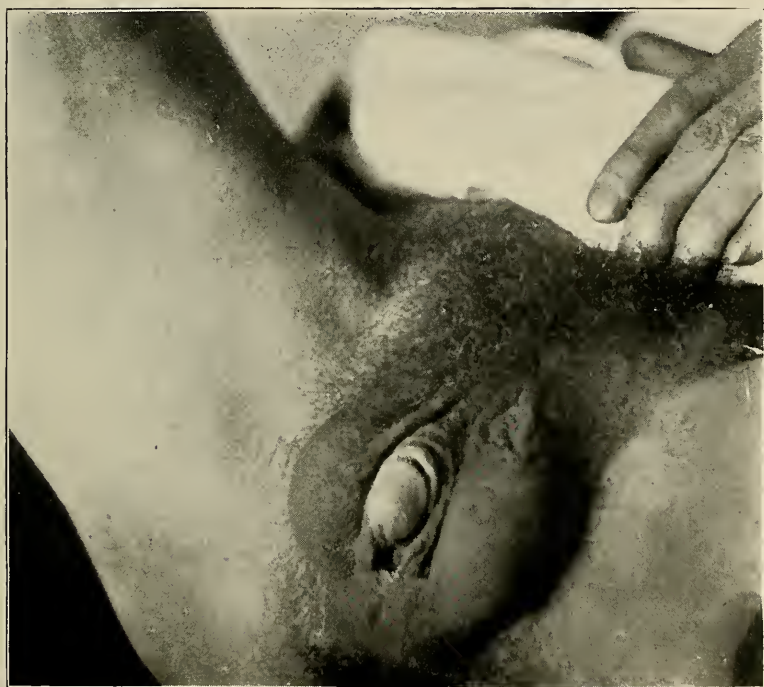
Fig. 50. Spurious hermaphrodism. Educated as a female. The general appearance that of a woman, but undoubtedly a case of hypospadias.

ceived, as many of these persons become, for pecuniary purposes, adept at misrepresentation. These cases are usually found to be males with hypospadias.

The study of the embryology of the two sexes, shows the similarity of the component parts up to a certain age, and the ease with which errors in development may give rise to hermaphrodism.

Until about the third.month of development, the genitals in the embryo, present the same appearance for both male and female, and rudimentary tissue for the formation of both sexes is present; as development advances, if the child be a male, the tissues for the opposite sex remain rudimentary, and *vice versa*.

Normal median union of the lateral surfaces of the urogenital sinus may be more or less interfered with, or the genital tubercle and its prolongation anteriorly may be arrested; or, if the child be a female, the genital furrow may close and the clitoris undergo abnormal enlargement. Embryonic errors of this kind, together with the presence of the rudimentary structure of the opposite sex, often presents a condition that is perplexing.

For examples of hermaphrodism, the reader is referred to current literature: American Journal of Obstetrics and Diseases of Women, Vol. VIII p. 616, and Vol. XVI p. 174. Canadian Lancet, Vol. XVI, p. 134. Dr. Fowler in the Transaction of the New York Obstetrical Society. American Journal of Medical Sciences, Vol. XXVI, p. 367. Chicago Medical Times Vol. XXVII, p. 401. Eclectic Medical Journal, Vol. L, pp. 13 and 425.

Diagnosis. When a child is born into the world, it is important that the proper sex should be determined. Thus, if a girl be declared a boy, in after years shame may grow out of the mistake. A careful examination should be made and the sex be declared in conformity with the preponderance of existing sexual organs.

We are now too far advanced in means of diagnosis to be guided by Aristotle's rule, that, " it is to be considered in which member it is fittest for the act of copulation." Both internal and external organs should be examined. An enlarged clitoris in the female is not infrequently present at birth, and should it continue to grow it may reach even to twelve inches in length.

Absent testicles and a diminutive penis certainly tend to mislead, but the majority of these cases can be proven to be males, with testicles undescended from the abdomen, and a

hypospadiac penis. The cases of large clitoris, associated with absent vagina and uterus, or with uterus emptying into the bladder, are of course, females, minus certain organs.

Regular menstruation is presumptive evidence of the

Fig. 51. Same as Fig. 50, with rudimentary penis raised, showing the perineal opening and the urethral groove. The testicles in the folds on either side.

existence of an ovary; but such flow may be absent even in an undoubted female, or it may escape with the urine.

Sexual impulse is mainly dependent upon the presence of testicles or ovaries. In certain cases, however, the feeling

for the opposite sex is entirely absent; but, in this seeming
neutral state, circumstances may alter cases. Again, it may
be abnormally increased; it may develop very young; and at
puberty, may lead to excessive degradation.

The perverted sexualism of these females may induce
them to become lovers of woman, and to practice *sapphism*
at an early age. Thus it will be seen that the direction of
sexual desire is not always diagnostic of the sex.

The general characteristics of the individual, the form,
the voice, the hair, are all conditions that should be con-
sidered in connection with the examination of the internal
and external genital organs.

In the newborn the genital organs are so diminutive, and
the mucous tissues so delicate in texture, that examination is
very difficult; but with probe and sound, and the delicate
touch of the experienced physician, the distinctive features of
the organs can be discovered. If instruments are used, great
care must be exercised not to injure the tissues.

When the sex is uncertain, it would be wisdom on the
part of the physician to pronounce the infant a *probable male*
and await developments, since less inconvenience would
arise from an error in this direction.

Treatment. The responsibility of the physician is two-
fold: first; to determine the sex, which can usually be
done by observance of the foregoing suggestions. Second;
to establish the usefulness of the sexual organs so that the
individual may be marriageable as well as capable of beget-
ting children.

In these cases operative treatment should be resorted to
between the age of three and six years, and should be directed
to render the parts as nearly normal as possible. Repeated
operations are necessary in some cases to liberate and render
useful these malformed organs. In males the treatment is the
same as *that* advised under epispadias and hypospadias.

In females it may be necessary *to open an atresia vulva*
or *vagina*, or to *amputate* an enlarged clitoris. Before re-
moval of a clitoris, however, the diagnosis of sex must be
positive lest the organ be a male penis.

Phymosis and Adherent Prepuce.

Phymosis is a contraction of the prepuce, and it is usually adherent to the glans penis. In a very large percentage of male children it is present at birth, or if the prepuce is elongated beyond the glans it may be brought on after birth.

The condition is due to too great a proliferating power in the outer layer of cells in the genital tubercle. The over development not only produces an elongated foreskin but the preputial orifice may be nearly closed in front of the glans penis.

The preputial opening may be small, and contracted; so much so that the urine can scarcely escape through it. Frequently the urine is so held back by the small opening that a dilatation or urinary pouch appears, causing more or less retention and dribbling of the urine from it.

In all male children the prepuce is more or less adherent to the glans penis at birth. In cases where retraction can be made the first appearance of the preputial orifice is that of a very small hole, but gentle manipulation will soon expose the reddened meatus and the foreskin will roll back on the glans until a circle,—the line of adhesion, will appear.

If the case is that of an infant the adhesions will readily give away, allowing the foreskin to be stripped back over the glans. As the child grows older, the adhesion becomes more firm and resisting. When the adhesions are broken up an accumulation of smegma præputii is found just back of the glans penis acting as a foreign body.

Where phymosis and adherent prepuce remain, the glans penis is held firmly within, and its growth is much retarded. The retained excretions of smegma and urine cause irritation and in some cases inflammation. Frequent erections are excited with intense pain as a consequence; a train of nervous symptoms may follow; and that, unless the patient gets early relief, is liable to be disastrous to his mental and physical condition.

Nervous symptoms are reflexed to other parts of the body

and are manifested in a great variety of ways. *Chorea, tetany, paresis, epilepsy, convulsions, feeble muscular action, strabismus, dysuria, nocturnal incontinence, paralysis, talipes, prolapsus ani, and malnutrition,* are among the troubles excited by phymosis and adherent prepuce, and have been cured by relieving the patient of the local irritation.

In young infants, many cases of restlessness at night, of defective nutrition, and of malassimilation have been greatly benefited by proper attention to the genital organs and a puny, irritable, wakeful boy baby has been rendered plump and happy by simply giving him a clean healthy glans penis.

In girls with irritation or hyperæsthesia of the clitoris, or nymphæ, we have a similar exhibition of reflex nerve symptoms and they demand the same scrutinizing cleanliness and attention as in the case of boys.

Diagnosis. The actual condition of the genitals is easily determined, but whether the nervous symptoms positively come from the irritation at the genitals, or from some other part of the body, is a question that is more difficult to decide.

It should be remembered that nearly every boy has an adherent prepuce, and that it should not be mistaken for the cause of nerve disturbance when the initial lesion is in the brain or spinal cord.

In every obscure case of nervous trouble in children, a careful investigation of the state of the genital organs should be instituted; in fact it is the part of wisdom to ascertain in every male child the fact that the prepuce and glans penis are separable.

Physicians are not excusable for overlooking this causal element of disease, and if there is any doubt remaining as to the cause of the nerve symptoms, the genital organs should first be placed in a normal healthy condition. This should be the first step in the treatment, and due attention to other things should come later.

Prognosis. The prognosis depends on our ability to relieve the local irritation. In cases of epispadias, or hypospadias, it may be hard to relieve the difficulty even in cases where its relief from local treatment seems clear.

Treatment, The object in the treatment is to attain the normal standard, and to secure a prepuce freely movable over a healthy glans penis. In the great majority of children this can be accomplished by due attention on the part of the physician, nurse or mother, in early life, and is accomplished by gentle manipulation and cleanliness.

Daily washing of the genitals should always be insisted upon in children; and, when carefully done by the mother or nurse, it occasions no excitement, and is the best preventive against priapism and masturbation. It is important to teach it to the child and if followed in youth it is looked upon as an ordinary act of cleanliness and will prove most hygienic. When the toilet is made, the prepuce should be well retracted and the sulcus back of the glans cleansed.

In infancy an adherent prepuce can be stripped from the glands with little difficulty and should always be accomplished early. In neglected cases, it, as a rule, is accomplished by the boy's own manipulations before he is eight or nine years old. He should be saved the necessity of performing this operation upon himself as the local irritation, and manipulation on his part has much to do with his acquiring the vicious habit of masturbation.

If the adhesions are so unyielding as not to give way upon firm retraction of the prepuce, it may be necessary to pass a probe around the glans to break up the adhesions. The separation should be carried back until the sulcus behind the corona is fully exposed, when all smegma should be thoroughly washed away. Sometimes the smegma is not removed easily, as it has become imbedded in the tissues. If necessary, an instrument should be used to scrape it away.

At first the prepuce should not be allowed to remain long behind the glans, as paraphimosis will result and great difficulty be experienced in its reduction. The prepuce should be made to move back and forth a few times and always be left returned over the glans as before.

If the above treatment with the free use of sterilized water is persisted in daily, it will in the largest percentage of boys secure a healthy and freely movable prepuce; and it is

far more practicable than circumcision when it can be carried out.

Slitting the prepuce. When the preputial opening is so contracted that retraction is impossible, and especially where there seems to be no redundancy of tissue, it is best to slit the prepuce on the dorsal surface. This is best done by passing a grooved director between the prepuce and the glans and following it with a curved bistoury or narrow bladed scissors, making the incision well back over the glans. Retraction and cleanliness can then be practiced as described above. If any swelling should take place a wet boracic acid dressing should be applied.

Circumcision. The removal of the prepuce by operation should be practiced where there is a redundancy, or elongation, of the prepuce far beyond the glands. An elongated prepuce is a great annoyance to the patient as it usually becomes contracted so that it prevents the exposure of the glans. Circumcision offers immediate relief and is to be performed only where there is an excessive development of the prepuce.

Nature intended the glans penis should be covered by the preputial hood, and as the removal of the prepuce means mutilation, it is always well to bear its function in mind; and by treatment to try and attain as nearly as possible the normal standard. The operator should guard against cutting the prepuce too short, or leaving a large amount of cicatricial tissue.

The operation can be performed under either general or local anæsthesia. If the base of the penis is constricted and the parts injected with a two per cent solution of cocaine the operation can be done without pain to the patient.

The prepuce is to be grasped by two pairs of catch forceps at about the junction of the mucous with the integumentary portion, the foreskin then put upon the stretch by an assistant, while the operator cuts it away with a pair of sharp curved scissors, cutting close to the glans, and a little shorter on the dorsum than it is below. He then retracts the integument and slits up the mucous membrane to the corona, stripping it from

the glans and turning it back. If necessary, additional trimming can be done with the scissors to make the edge of the mucous membrane approximate the integument. A few catgut sutures can be inserted if thought best, but as a rule they are not necessary. Iodoform or boracic acid powder is applied, and a dressing of borated cotton wrapped around the penis to form a cone from the base to the meatus, and secured by the use of simple collodion.

Urination takes place through a very small opening at the apex of the cone.

Union will be speedy and non-suppurative. If erections take place the dressing pushes the penis back in the cellular tissue at its base. The cotton should be removed on the fourth or fifth day and the parts dusted with a dry powder.

CHAPTER XI.

IMPERFECT FORMATION OF NATURAL OPENINGS (CONCLUDED).

Imperforate Anus—Absence of the lower part of the Rectum and Anus—
Occlusion of the Rectum at some distance above a normal appearing Anus—
Rectum terminating in a Fistula—Atresia Ani Urethralis, Atresia Ani
Vesicalis, Atresia Ani Vaginalis.

Malformation of the rectum and anus results from the arrested development of the parts during the embryonic period of their formation.

A brief description of the development of these parts will assist in gaining an understanding as to the manner in which errors in the formation of the rectum and anus are brought about.

The earliest formation of the alimentary canal is that of a shut sac with its closed end within the caudal extremity of the embryo. The sac is formed from the hypoblastic membrane and naturally remains within the surrounding mesoblastic structures.

The epiblast invaginates the mesoblast to form a common opening for the intestine and uro-genital sinus. The inflexion of the epiblast finally approaches the sac above and communicates with it by a solution of continuity in the septum between the two. This takes place in the latter part of the second month when the alimentary canal communicates externally.

It is seen that at an early date there is a common orifice for the rectum and uro-genital sinus; while the uro-genital sinus develops into the deep urethra, which is later divided by the development of the perineum, which appears as a vertical septum dividing the cloaca, and is completed in the latter part of the third month.

An arrested development, or an irregularity of the process of formation of any of the parts entering into the formation of

the rectum, anus, perineal septum, bladder or deep urethra, are etiological factors in the malformation of these parts.

IMPERFORATE ANUS.

Imperforate anus is caused by a diaphragm of greater or less thickness, and it may consist of simple mucous membrane, or the mucous membrane may be covered with more or less areolar tissue and true skin.
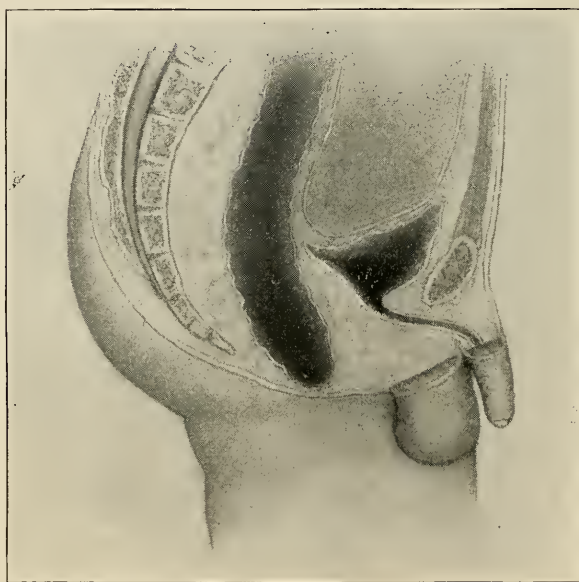
Fig. 52.   Imperforate anus.

All the other structures about the rectum usually appear normal. Often at the site of the anus there is a bulging of of the tissues while the infant is straining.

Diagnosis. The diagnosis is made by observing that the infant passes no feces; and, by examination, the presence of fluid or gas can sometimes be determined beneath the bulging diaphragm.

Prognosis. Unless the infant is relieved by the third or

fourth day, it soon dies; or, if the fecal substance regurgitates by way of the mouth, it may live for a time.

Treatment. Relief depends upon an operation to form a natural anus. This is done by placing the infant on his back, with the thighs drawn upward, and making an incision carefully through the central point, evacuating the feces, and washing out the lower bowel thoroughly. The redundant tissues should be trimmed away and the mucous membrane stitched to the integument with fine catgut. Care should be exercised in making the anus as near natural as possible, and not to injure the fibers of the sphincter ani muscle.

The parts are to be dressed with boracic acid powder and borated gauze. The dressing should be renewed as often as it is soiled by the infant. Healing is by first intention and the result is satisfactory.

Absence of the lower part of the Rectum and Anus.

In this variety, the arrested development which produces the malformation is such as to leave the termination of the bowel at a variable distance from the position of the natural anus. The bowel terminates in a large pouch, usually about the middle or upper part of the sacrum, or about two inches above the perineum. The pelvis below is often narrowed, and is filled with cellular tissue. Frequently a cord of longitudinal fibers marks the natural situation of the rectum and terminates below where the anus should be. At the site of the anus the skin may be smooth and even; or there may be either a slight protrusion or an indentation.

Diagnosis. The external appearance of this condition is plain, but it is difficult to determine the approximation of the blind rectal pouch to the perineum. A narrow pelvis, with nearness of the tuberosities of the ischium is a sign of the high termination of the rectal pouch. The urethra and bladder, or, if a female, the vagina also, together with cellular tissue fills up the concavity of the sacrum. Passing a probe into the bladder may be of some assistance.

Prognosis. These cases usually die on the third or fourth day. However, cases have been known to live a considerable time by vomiting the contents of the bowels two or three times a day. They are sometimes relieved by an operation, but in some cases where the opening in the bowel is made, it is so unnatural that it does not satisfactorily serve the purpose of an anus.

Treatment. The only relief is by operation and the method should be directed toward the formation of the best possible opening for the bowels. The operation should be
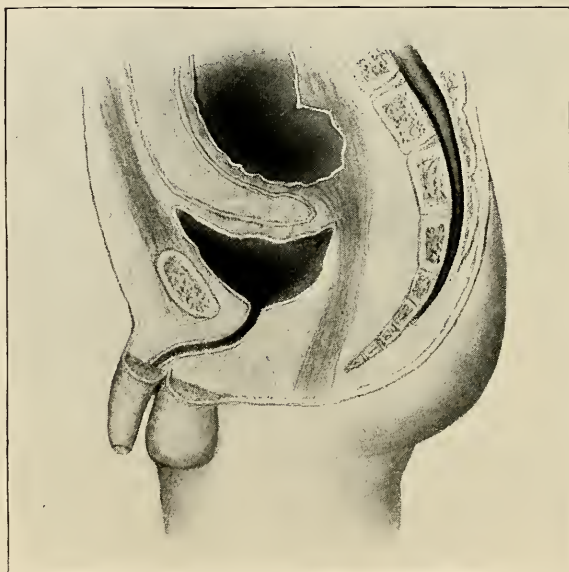
Fig. 53. Absence of the anus and lower part of the rectum.

performed as soon after birth as possible. During the first twenty-four hours is the best time, and it can be done without anæsthesia. An attempt should be made to reach the rectal pouch through a perineal incision. If the outlet of the pelvis is sufficiently large to allow the introduction of the index finger and instruments, it can probably be accomplished. The infant is to be held in the lithotomy position and the incision made in the median line from the coccyx to the root of his

scrotum. After it is deepened to about one-half inch with the
scalpel, then blunt dissection with the index finger can be
carried to the depth of several inches, bearing in mind to keep
in the median line and close to the sacrum. If rudimentary
fibers be felt, it is well to follow them to the bowel. A probe
in the bladder or in the vagina is of some assistance in locating
the rectum. When the rectal pouch is reached the adhesions
around it should be ruptured with the finger, when it can
be grasped by a pair of forceps and incised with scissors, be-
hind the forceps. After the bowel is thoroughly evacuated
and washed, it should be brought down if possible, and
sutured to the integument. In some cases it can be brought
down before it is opened, which it would be well to do.

If this can be done, the success following the operation is
mostly assured, as usually the muscles about the new open-
ing gain control over the movements.

If it is impossible to bring the bowel down, then a good
sized metal drainage tube must be secured in the wound to
facilitate the escape of the feces and to prevent the tissues
reuniting. The difficulty is in keeping the tube in place until
the healing process is completed so as to secure a servicable
outlet for the bowels. In some cases (Annual of the Medical
Sciences, 1888, Vol. II) where the bowel was too short, the
coccyx has been removed, and the incision carried along the
sacrum far enough to allow the gut to come to the surface.

After the wound is dusted with iodoform powder, a moist
dressing should be applied and changed often, the parts
bathed with warm boracic acid solution and the dressing re-ap-
plied.

If the dissection through the perineal region does not
reach the bowel, the surgeon should consider the advisability
of abandoning the operation in that region and doing a laparo-
colotomy and thereby securing an artificial anus on the ab-
domen.

OCCLUSION OF THE RECTUM AT SOME DISTANCE ABOVE A NORMAL APPEARING ANUS.

This malformation is the result of the failure of the solution of continuity between the hypoblastic pouch above and the invaginated epiblast below. As a result of this embryonic failure there is no communication between the two pouches.

The anus is normal in appearance, but ends in a cul-de-sac, and the rectum ends in a blind pouch at a variable distance above this point.
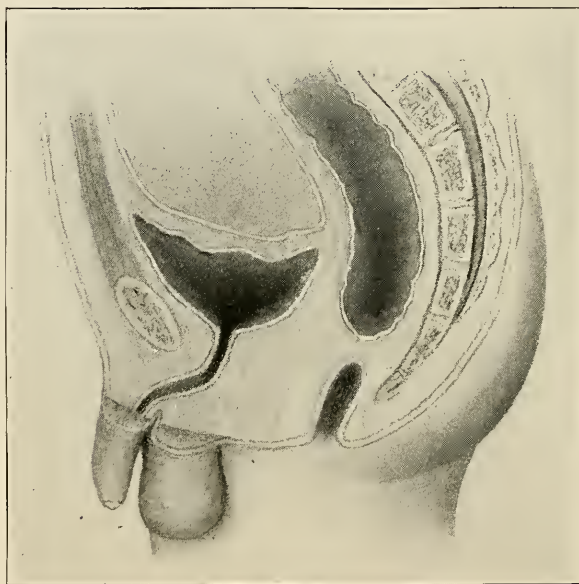
Fig. 54.   Occlusion of the rectum at some distance above a normal appearing anus.

The separation between the two may be a membranous partition of greater or less thickness, or the anal cul-de-sac may lead to the vagina or urethra, while the rectum ends in a pouch above. The symptoms will be those of complete obstruction of the bowels.

Diagnosis. The character of these cases can be easily determined by examination with the index finger or a probe

passed into the anus. The diagnosis is seldom made early as the external appearance is quite natural. It is only when the nurse or mother notices that the child passes no fecal matter, that it suffers pain, that the belly becomes swollen or vomiting begins, that the physician's attention is directed to the case. Its nature is then made known by examination.

Prognosis. From the fact that the diagnosis of this malformation is not made until grave symptoms are present, the prognosis becomes very unfavorable. If it should be discovered early, there might be a relief for the infant through operative treatment.

Treatment. The only treatment is to operate in such a manner as to find the rectal pouch, bring it down and stitch it to the tissues below. This can best be done by enlarging the anal cul-de-sac posteriorly, along the coccyx and sacrum, and following up to the rectal pouch and then dividing the adherent tissues and bringing the rectum to the skin below and securing it there with catgut sutures. The repair in the adjacent tissues must be completed so as to make the parts as nearly normal as possible.

Puncturing the partition through the anus has not proven a valuable method of reaching the bowel, as the dangers attending it are greater.

If, after due effort, there should be failure to reach the rectal pouch from below, then it is well to close up the incision already made, and attempt to reach the gut by an incision in the left groin—*laparocolotomy*.

The Rectum terminating in a Fistula.

In these cases, there are a great variety of types manifesting in themselves, the errors of nature, in faulty production of the orifices, by embryonic cell proliferation and the coalescence of parts.

They present an absence of the anus, and the rectum narrows down to a mere fistula, which may have its opening at any point in the perineum or sacral region. The same errors in embryonic development may throw the rectal fistula into

the urinary tract or generative organs, and the feces be discharged by one of these outlets; or there may be several fistulæ terminating at different points; or the urethra or vagina may terminate in the rectum.

Stenosis of the lower part of the rectum and anus often occurs.

These cases of congenital stenosis, where the rectum narrows down to a fistula with its opening at the anus, are the ones that are usually overlooked, as they allow the semi-fluid fecal matter to escape to a considerable extent. The move-
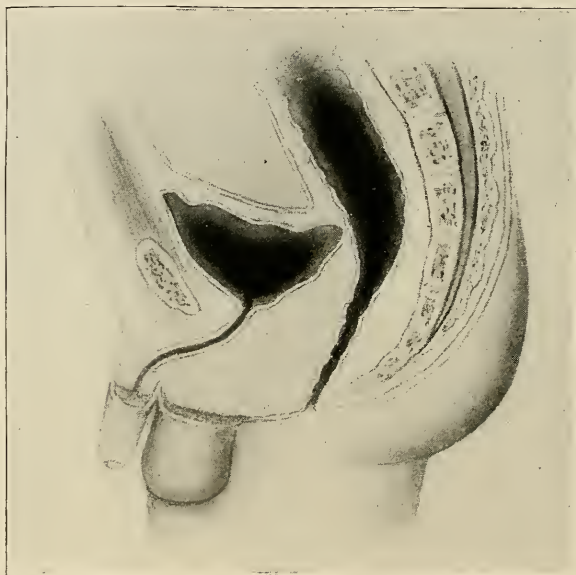
Fig. 55.   Rectum terminating in a fistula.

ments take place sufficiently to prevent symptoms of complete obstruction.

When the child grows older and the fecal substance gets harder, the accumulation takes place in the rectum, the abdomen becomes bloated, and the child strains ineffectively at stool. Laxatives are administered, but only a little fecal matter passes; the child is in such pain that attention is called to it and the nature of the deformity is determined.

The opening of the fistula instead of being at the normal point of the anus, may be anywhere on the perineum.

Diagnosis. Diagnosis of fistula with the opening externally, is very simple. Absence of the anus and presence of a fecal fistula determines the malformation.

Prognosis. Prognosis is more favorable than in those cases with complete occlusion.

Treatment. If the infant does not have sufficient evacuation, it is well to dilate the stenosis or fistula with graduated bougies every day until the opening is sufficiently large to allow free evacuation. If this fails, or when the child has arrived at the age of from three to six years, an incision through the perineum should be made, to reach the bowel, the fistula should be dissected out, and the bowel brought down and stitched to the integument, care being taken to preserve all the functions of the parts.

Atresia ani urethralis—vesicalis—vaginalis.

Where the rectum or the fistula ends in the urethra, bladder or vagina, it is called atresia ani urethralis, atresia ani vesicalis, and atresia ani vaginalis respectively.

Atresia ani urethralis is that form of malformation where the rectum communicates with some portion of the male urethra, allowing the escape of fecal matter. It escapes for the most part at intervals between urination. There is very little feces in the urine. The anus is absent.

Atresia ani vesicalis is that form of malformation where the rectum communicates with the bladder, either by a narrow orifice near the base of the organ, or by an opening near its fundus. In this case, the fecal matter passes with the urine and is mixed with it. The amount of fecal substance will depend upon the size of the opening. If the opening between the bladder and the bowel is small, the symptoms of insufficient passage of fecal matter are present.

Atresia ani vaginalis is that form of malformation where the rectum terminates in the posterior wall of the vagina. There may be a small opening, allowing an insufficient escape

of fecal matter, or the opening may be large enough to cause incontinence of feces.

The opening may be situated at any point along the posterior vaginal wall. The anus is absent. Where the feces escape sufficiently, a patient with this malformation may reach adult life; and, in some cases, has lived happily with a husband and raised a family.

Diagnosis. The diagnosis of these abnormal fistulous openings can usually be made by observing where and how the escape of fecal matter takes place. In all cases of
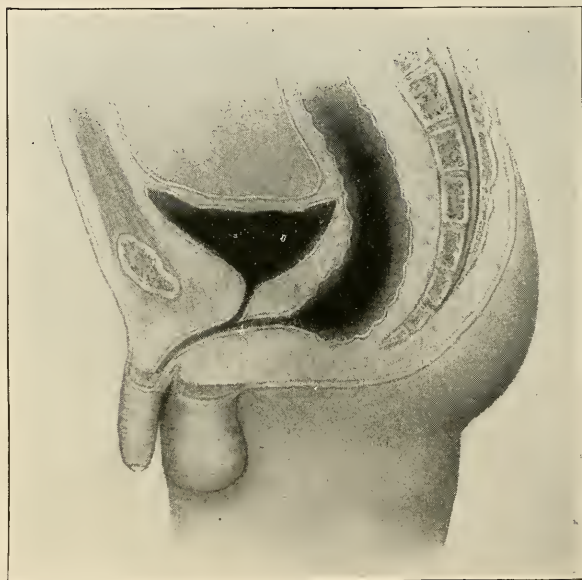
Fig. 56.   Atresia ani urethralis.

occlusion of the rectum, or absence of the anus, it is well to look carefully for fecal stains on the napkin, or to investigate the urine, as this class is of more frequent occurrence than all others taken together.

Prognosis. The prognosis depends, first; upon the size of the fistula or outlet of the bowel, as to whether it will allow the fecal substance to escape with sufficient freedom or not. Second; upon the success of an operation to relieve the

bowels, provided there should be serious symptoms from retained feces. The operation is more or less severe. The mortality is high, partly from the operation and partly from the weakness of the patient.

Treatment. If, as often happens, the patient suffers no inconvenience from the malformation, any operation towards producing a cure may be postponed until an age is reached when the greater development of the parts will con-
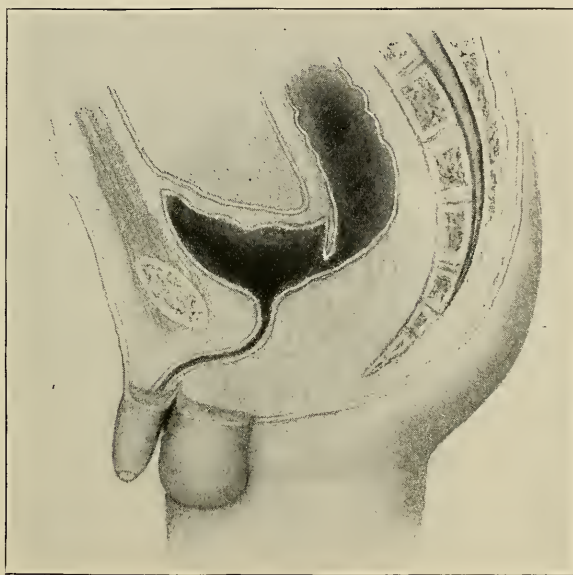
Fig. 57.   Atresia ani vesicalis.

duce to a more favorable result. With this end in view, it is well to look after any inconveniences that may arise in the case.

If the fistulous opening is too narrow to allow free discharge, the physician should strive to overcome this by the passing of graduated bougies, for the purpose of dilatation.

If a radical operation should be decided upon, it will consist in incising the perineum and carrying the dissection up into the pelvis high enough to find and loosen the rectum so

that it can be brought down and stitched to the integument. Considerable care should be taken in shaping the new anus.

The fistulous opening in the urethra, bladder, or vagina can be closed through the same opening before the bowel is pulled down. If the fistula is in the urethra or bladder, a catheter should be allowed to remain in, to conduct away the urine. If the fistula opens into the vagina, the latter should be well packed with gauze so as to give support to the soft and newly forming tissues.

Fig. 58. Atresia ani vaginalis.

Iodoform powder and gauze should be used for dressing. At the time of the first dressing it is well to place a piece of gauze or a drainage tube into the newly formed anus, but if the bowel is well secured to the integument, it is not necessary after the first dressing. The feces should be kept liquid and the dressings changed as often as they are soiled. Healing will probably take place by first intention.

CHAPTER XII.

CONGENITAL DISTORTIONS.

Congenital Dislocation of the Hip—Dislocation of the other Joints—Club-Hand—
Congenital Club-Foot—Congenital Rickets—Congenital Syphilis.

Congenital Distortion exists principally as a diversion
in the position or shape of the extremities. Under this head-
ing we may consider the distortion as dependent upon some
abnormal influence—mechanical, maternal or hereditary, which
was present before birth.

The deformity may or may not be noticeable at birth.
Examples of those which are abnormal at birth, are some
cases of dislocations, congenital club-hand and club-foot.
Those which are not noticeable at birth, but appear as
soon as the child begins to make use of the parts, may be dis-
locations, and defects from congenital rickets or syphilis.

Congenital Dislocation of the Hip.

Congenital dislocation of the hip is an abnormal relation
of the structures entering into the formation of the hip-joint.
The name is somewhat misleading as it applies in some cases
where there is no dislocation in the true sense of the term.

There may be one or more of a variety of anatomical con-
ditions present. The abnormal relation may be due to relaxa-
tion of the ligamentum teres, or of the capsular ligament. It may
be a defective development of the cotyloid ligament, or the
defect may be in the rim of the acetabulum. It may be a
defect in the formation of the bone, either in the bottom of the
acetabulum, or in the head and neck of the femur. The con-
genital dislocation may exist only on one side, or it may be
present in both hip-joints. Usually the other parts of the
body present a natural appearance.

Etiology. The abnormal relation of the parts in congenital dislocation, is undoubtedly due to a defective development, the foundation of which, is laid during the formation of the parts while in embryo.
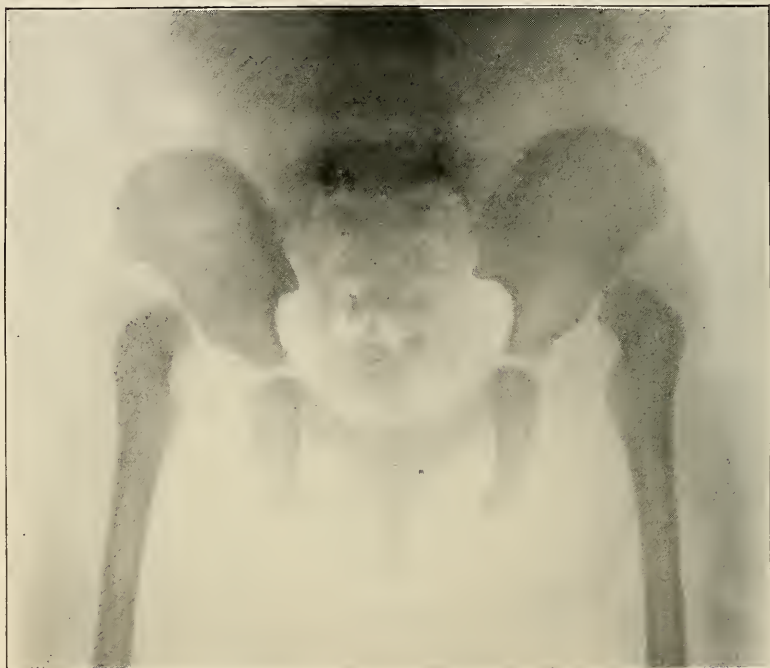
Fig. 59. Skiagraph of a case of double congenital dislocation of the hip, showing the defective development of the bones in a child, aged four years.

The theory of defective development in the embryo, as advanced elsewhere in this work, is that of mechanical disturbance of the embryo, maternal impressions and heredity. Of these, mechanical disturbance seems to be the most common cause. (We have a case in the clinic at the present time of double congenital dislocation of the hips; whose mother, during the early months of her pregnancy was nursing her five year old boy who had undergone excision of the hip-joint for hip disease at our hospital.)

Pathology. In early life in congenital dislocation, there is

an abnormal degree of motion at the hip-joint. Besides the normal movements present, the head of the femur is not held firmly in its natural situation in the acetabulum, but is permitted to move from it. The usual displaced motion is upward and backward.

The degree of displacement varies greatly in different cases. In some, there is only a relaxation of the ligaments,

Fig. 60.   Skiagraph of congenital dislocation of the right hip in a case aged fourteen years.

allowing a partial displacement, or perhaps a weakness; in others, there is such laxity that the patient can dislocate the hip joints at will, by muscular effort, so that the head of the femur can be felt against the ilium; while in others the bones remain displaced constantly during the act of walking.

As a rule the head of the femur is not natural. It may be flattened or entirely absent. The cavity of the acetabulum presents a similar defect. The capsular ligament is always present but usually much distended as the pressure from the weight of the body bears heavily upon it.

In a case that is not treated, the tendency is toward a progressive increase of the deformity. The muscles around the joint develop unnaturally. The head of the femur may rest against the innominate bone, and form a socket away from the acetabulum. In time, the head becomes united by ligamentous attachments, in the new situation. The line of equilibrium in the body is altered and consequently an unnatural gait, and secondary body curves, must develop.

Symptoms. From the time the child learns to walk the symptoms are observed. The peculiar waddling gait, or swaying of the body from side to side, is characteristic. The back is curved forward, and the hips are prominent.

Where the dislocation is only on one side, the gait is that of an exaggerated limp. There is no pain unless over exercise has caused irritation. A child with this deformity will walk farther than one would think from the manner of its gait. When accustomed to walking, they endure it nearly as well as other children.

Diagnosis. The deformity is usually overlooked in early life, but after the child walks well, the diagnosis may be made at a glance.

Examination reveals an unusual laxity at the joint. If the bone is out of place it can be determined by the application of " Nelaton's test." This is only applicable, however, in the severe cases, or in those in which there is shortening of the extremity. As the child lies on its back, the perineum is broad; and, if the muscles are relaxed, the extremities are abnormally everted.

The deformity can usually be differentiated from other troubles by the history. In bow-legs and lordosis the gait resembles this affection, but in them the hip is found to be normal. In infantile paralysis the laxity of the muscles prevails throughout the extremity.

Prognosis. If left to themselves, these patients are able to walk, but they do not recover from the deformity. The awkward gait continues, and in some cases grows worse.

Treated cases usually improve, but the cure depends somewhat upon the extent of the deformity, and the time de-

voted to treatment. Many cases recover entirely, if treated during the active growing period.

Treatment. The desired end to be reached in the treatment of congenital dislocation of the hip, is to secure the parts in their normal situation, and at the same time, to permit mo-

Fig. 61. Congenital dislocation of the hip. (Park.)

tion, until the normal relation is established by nature, and the patient is able to maintain that relation in the act of walking.

The treatment is a difficult task as the methods proposed

are, generally, so insufficient; the acetabulum imperfect, perhaps almost wanting; a flattened and deformed head of the femur; and the strong muscles and body weight antagonizing every therapeutic measure.

Mechanical treatment. The conservative treatment is pursued by the plan of continuous extension. This may be accomplished in different ways. The writer has succeeded by the use of a modified double long hip splint by day, and bed extension by night. Of course the degree of extension must depend upon the case, and the work to be accomplished. In the majority of cases, extension should be sufficient only to hold the parts in their normal relation to each other. This method of treatment should be persisted in for several years, or until the parts become more fixed in their normal place, or until ossification is completed.

German surgeons accomplish the same result by the constant application of a corset, and pelvic bands of plaster of Paris, silicate or felt. Some surgeons of this country secure the bones in their normal relation by plaster of Paris and bed extension for a long time, and afterwards allow a patient to go about with an extension splint. (Post, Lovett, Brown.)

Under the most favorable circumstances, the mechanical treatment, especially in children, will effect a cure. When the patient has passed childhood this plan is unsatisfactory. If the patient has reached adult life and can walk, it is well not to attempt treatment; but if walking is very difficult or impossible, then operative treatment may be demanded.

Operative treatment. In desperate cases, where deformity is marked, or where inflammation has existed in the unnatural joint sufficient to cause a contraction of the muscles about the hip, then, in order to overcome the deformity, an operation must be performed.

The operation should be directed toward restoring the parts to as nearly their normal relation as possible. Division of the muscles and tendons, and perhaps excision of the bone may be necessary.

The subcutaneous division of those tendons that prevent a normal degree of motion, may suffice. Hoffa makes an

open incision down to the femur, extirpates the capsule, enlarges the acetabulum, reduces the dislocation by dividing resisting tendons, inserts drainage, and finishes with a plaster of Paris cast to secure the parts. The results following this operation are said to be favorable. It still remains a question whether this plan should be attempted upon patients that have reached adult life, as in them the tissues do not readily form into a useful joint after excision of the hip.

Dislocation of other Joints.

Although hip-joint dislocations are more common than those of any other joint, it is of importance to call attention to the fact that congenital dislocation may exist in any joint of the body.

The cranium has been found to be dislocated in monstrosities. (Guerin.) The rotation of the vertebræ on each other has existed as a congenital dislocation. (Fleischmann.) Dislocation of the lower jaw is reported. (Guy.) Dislocations have been noted at both the sterno-clavicular and acromio-clavicular joints. (Guerin.) Congenital dislocations of the shoulder in both adults and infants have been found. (M. Smith.) Authenticated cases are recorded of dislocations at the elbow, of the wrist and of the joints of the fingers.

Dislocation of the tibia forward, is one which attracts considerable attention, because the knee flexes in the reverse direction from the normal. The limb can be straightened easily but when left to itself it resumes its former position.

There may or may not be co-existing deformities. These dislocations may be lateral or bi-lateral. There is always an alteration in the structures of the joint according to the degree of the deformity. The joint structures are usually all present, but some are rudimentary and others are over-developed.

If left to itself the deformity becomes more marked as age advances. In some cases some usefulness is gained to the part, but a spontaneous cure never results.

Treatment. When the deformity is recognized and treated

while the patient is very young, a simple fixation treatment will answer. The parts should be placed in their normal relation to each other, and retained there a sufficient length of time so that they will remain in position; and then with passive motion daily applied the joint will soon become useful.

If there is rigid muscular resistance the tendons should be divided, and the deformity corrected by force if necessary. A plaster cast best serves to fix and protect the parts for a few weeks, and then passive motion can be employed, and a supportive brace worn until the parts gain their normal usefulness.

Club-Hand.

Club-hand is a deviation of the hand from its normal relations to the line of the forearm. The condition is analogous to that of dislocations of other joints and could well be called dislocation at the wrist-joint.

The deformity varies in different cases, from that of a slight impediment in straightening the wrist, to that of having the hand doubled upon the forearm.

Club-hand is spoken of as being *dorsal* or *palmar* when the deformity is towards extension or flexion. It is *radial* or *ulnar* (ulnar sometimes called cubital) when the deviation of the hand is inward toward the radius, or outward toward the ulna. Usually two of these varieties are combined.

When the hand is strongly flexed and drawn toward the radius it is called *radio-palmar*. The other combinations are *radio-dorsal*, *ulnaro-palmar*, *ulnaro-dorsal*, *cubito-palmar* and *cubito-dorsal*.

Club-hand is not a common deformity. Its most frequent occurrence is that of the radio-palmar variety. Frequently it is associated with other distortions or malformations. It may exist on one hand or on both, or is sometimes met with as an acquired deformity. It may be secondary to traumatism or paralysis. Its most frequent occurrence, however, is in the congenital form.

The causes of congenital club-hand are the same as those described under malformations. In some cases there is only

deficiency in the length of the soft tissues. The muscles, tendons and fascia are too short to allow the hand to be brought into line with the forearm. In other cases there is also a defect in the bones. One or more bones may be absent in part or in whole. This may be true of the radius, ulna or the carpal bones, thus allowing the hand to be easily diverted or dislocated to one side. A variety of anomalous conditions of bones, muscles, vessels and nerves may occur.

Symptoms. The hand is rigidly held in a deformed position, but admits of some motion at its articulation with the forearm. The lower end of the radius or the ulna may push
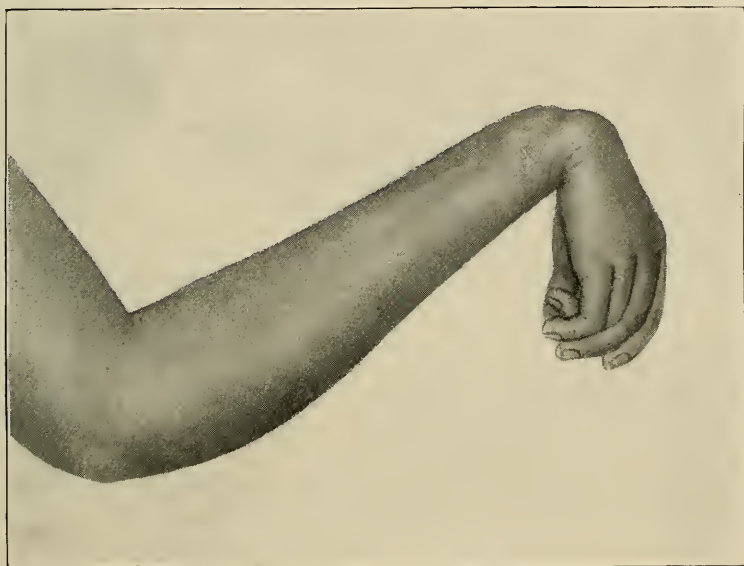
Fig. 62. Congenital club-hand.

out permanently against the skin. There is usually some atrophy of the hand and fingers. The hand is of some service to the patient, but at best is weak and unnatural.

Diagnosis. The diagnosis is evident, as the name club-hand covers all these malpositions.

Prognosis. The tendency in these cases is toward progressive deformity, rather than towards improvement.

Treatment. When the treatment is begun early, there is a chance to effect a cure by mechanical apparatus, fixed to

the extremity so that the parts will be held in their normal relation to each other. In mild cases this treatment will also effect a cure. The mechanical treatment can sometimes be accomplished by using any forms of splints that will keep the hand in position, changing them as often as necessary for circulation. Later, and when motion is desired, the best form of support is the regular club-hand brace with elastic spring extension. The brace should be worn until the extremity will act normally without it.

Operative Treatment. Where it is impossible to correct the deformity by mechanical appliances we resort to operative treatment. The operation is for the purpose of dividing the restraining tendons or ligaments so that the hand may be easily
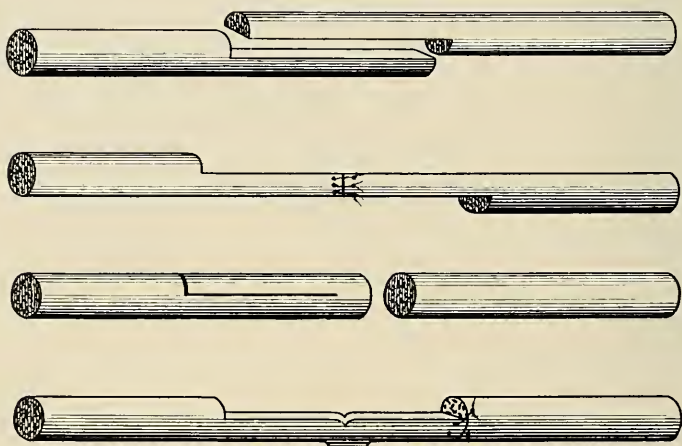
Fig. 63. Showing method of tendon lengthening.

straightened. This is best accomplished by open incision. The incision is made over the contracted parts and carried down to them, and the division of the fascia is easily done. If tendons and muscles are too short, it is best to lengthen them by the method of *tendon lengthening* as represented in the illustration.

The tendons should be lengthened just enough to allow the hand to be straightened. It is usually necessary to lengthen a number of the tendons as more than one muscle

is involved. After the tendons and the sheaths of the tendons are carefully stitched with catgut or fine silk, they are replaced in their natural situation; the external wound carefully sutured and antiseptic dressings applied. All this should be done under the most strict aseptic precautions, as union must be by first intention in order to obtain a good result.

The extremity is placed upon a suitable splint and held in a natural and straight position. This position should be maintained throughout the treatment. After the soreness disappears, passive motion should be practiced.

Sub-cutaneous tenotomy is not advisable for club-hand, as the tendons do not re-unite in a way that gives the power of muscular action.

Congenital Club-foot.

Analogous with congenital club-hand is that of congenital club-foot. It is usually manifest as a partial dislocation between the foot and leg, and also between the foot bones. The toe is usually extended and drawn inward—talipes equino-varus; although other forms are occasionly met with as talipes valgus or talipes calcaneus. For detailed classification of this deformity, the reader is referred to the chapters on talipes.

In congenital club-foot, the deformity is present at birth; and as age advances, it even ·becomes more marked. All that has been said in regard to the causes of congenital dislocations, and club-hand, is equally true of congenital club-foot. These several distortions sometimes co-exist and are dependent upon the same general etiological factors.

Symptoms. The symptoms vary in different cases. For the most part they do not attract much attention until the child begins to walk, and then the weight of the body is borne abnormally on the unnatural part of the foot. The child learns to walk with comparative ease, but over exercise produces fatigue and causes the development of large calluses at the points of the abnormal pressure. These calluses frequently become irritated or inflamed and prevent walking. The gait of a club-foot child is characteristic.

If an early examination be made it will be found that congenital club-foot can be easily straightened by manipulation. During infancy, as a rule, the foot can be easily drawn into its normal relation with the leg by the fingers, and with-
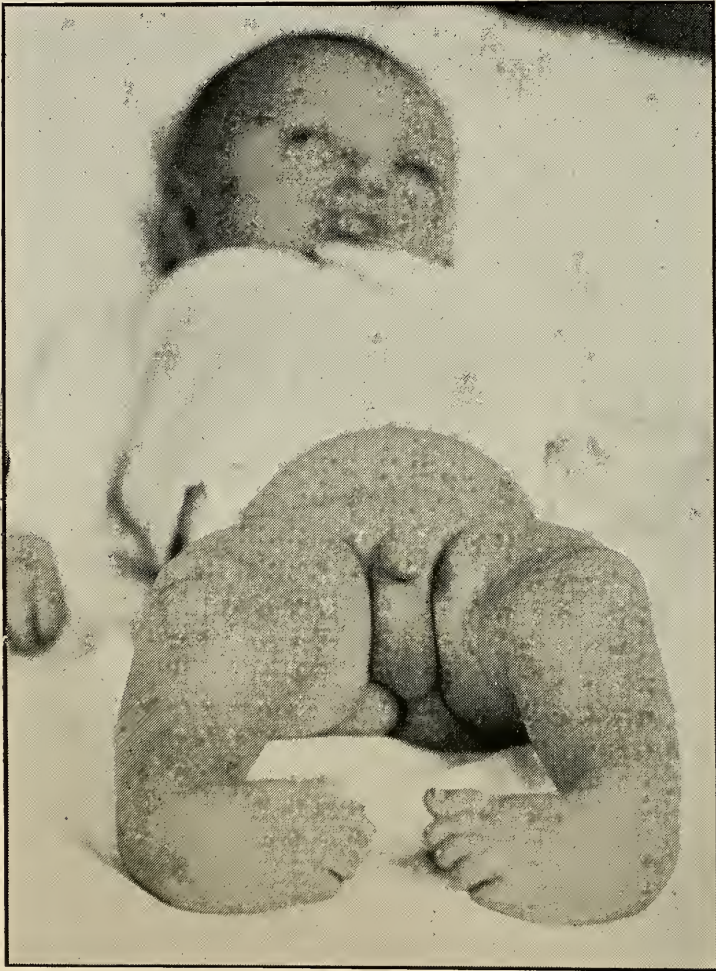
Fig. 64.   Congenital club-foot.   (L. E. Russell.)

out making the infant cry. As age advances, the parts become more rigid and reduction is more difficult.

There is an occasional case of congenital club-foot, where at

the time of birth, the parts are fixed and unyielding to manipulation. In some of these severe cases there is congenital distortion of the bones as well as of the soft parts. The cuboid and scaphoid bones of the foot may be abnormal in size and shape.

Treatment. The treatment should be begun as early as the deformity is recognized; and should be directed toward correcting it, and holding the foot in proper relation to the leg. If begun early, it can usually be accomplished by very simple means. The position of the foot may be secured with a common bandage applied so as to hold it in position. Strips of adhesive plaster may be used to hold the foot in its proper place. Some form of splints or braces may be used to accomplish the same result.

A cure can be effected by the above simple methods only when begun early, and when the deformity can be easily reduced by manipulation. Where the parts are more firmly fixed in the distorted position by the unyielding tendons and fascia, then operative treatment is necessary in order to reduce the deformity.

Operative treatment should be so instituted as to divide or lengthen the structures that are too short to allow the foot to be straightened. Usually, sub-cutaneous tenotomy and some force applied to the foot is all that is necessary to reduce the deformity. In some cases, the division of the fascia is necessary, while in others, portions of bone must be removed. (For description of operations, see talipes.)

In every case, the object to be accomplished is the thorough reduction of the deformity at the beginning of the treatment, and by operation if necessary. The position of the foot is secured by plaster or other suitable apparatus until the soreness is relieved, and then some form of mechanical contrivance is worn to retain the position that has been gained by the operation. If the patient is walking, a club-foot shoe is proper, and should be worn until the usefulness of the foot is assured in its natural relation to the leg.

Congenital Rickets.

Rickets is chiefly a disease of the osseous system, and when congenital the bones are abnormally soft and pliable. There is present from birth a deficiency in the strength and tone of the structures of the whole body, and as development advances it is observed mostly in the lower extremities. Many distortions and deformities of the bones characterize congenital rickets.

Etiology. The disease may be attributed to a defective vitality or weakness transmitted from the parents to the offspring, or the defect may be inherited from the father or mother alone. There is usually a history of some disease in the parent that might account for the deficiency in strength and growth of the offspring.

Pathology. There is evidence of defective development in the fœtus, with defective nutrition which continues after birth, chiefly characterized by the growth of the cartilaginous portion of the bones, and a deficiency of lime in these structures, making them soft, so that they are easily cut with the knife, and so pliable that they bend from the weight of the body. Rickets usually manifests itself, when congenital, about the second or third month, or before the fifth.

Symptoms. Infants suffering from congenital rickets are small, weak and poorly developed. All the bodily functions are sluggishly performed. From birth onward, they are subject to various ailments, never rugged or healthy, and under the best of care, they do not grow strong and vigorous. As age advances the defects of development in the bones of the face, and the defects of general nutrition give them an aged expression. The lower extremities may be paralyzed; or the act of walking delayed, while dentition is retarded; while varied deformities of the bones appear, especially of the extremities, from the superimposed body weight.

Prognosis. Children with congenital rickets usually die in infancy from diseases incident to childhood.

Diagnosis. The diagnosis is not difficult when the period

arrives when the child should begin to walk, but before that time the defective development and general puny condition of the infant is sufficient to enable us to make a correct diagnosis.

Treatment. It has been found that treatment to restore the lost functions of the nervous system effecting nutrition, and to supply the deficiency of lime in the bones, gives the best results.

A combination of cod liver oil and lacto phosphate of lime, with general hygienic means and good feeding, accomplishes much. (A greater detail of treatment will be given under the general subject of Rickets, section vi.)

Congenital Syphilis.

Syphilis may be communicated to the foetus by the ovum of the mother, or the spermatozoon of the father, who are suffering from the disease.

Pathology. Congenital syphilis is the same as secondary syphilis in the acquired disease, and is essentially a blood pollution with mal-nutrition. The disease being in the embryo may be latent or may be ante-natal resulting in stillbirth, or it may manifest itself after birth, usually not later than the fifth month.

Symptoms. An early symptom is an eruption on the skin appearing as an erythematous rash, or it may be in yellowish blotches or discolorations of the skin, or there may be irritation of the mucous membrane of the nose. Ulcers, papules or blebs are commonly present. When the disease develops, late gummata or nodes may appear.

Deformities peculiar to congenital syphilis are shown in the teeth. The second central incisors when cut, are narrow, thin and short, with a crescentric notch on their cutting edges, formed by the breaking away of the substance of the teeth.

In the long bones the epiphises and diaphyses may become diseased and result in ulceration and extrusion of the dis-

eased part of the bone; or there may be abnormal union causing deformities and shortening.

The frontal bones of the skull may become thickened,
while the bone substance is atrophied; and this diffused or
circumscribed condition may be seen in the other bones of the
cranium.

An inflammation of the bones of the hand, an osteitis or
periostitis of the phalanges may occur in hereditary syphilis
and cause deformity.

Diagnosis. Where the symptoms, or a number of them,
are present with evidence of malnutrition, anæmia and debility, a diagnosis can be made with certainty.

Prognosis. Congenital syphilis usually causes the death
of the child in utero, or soon after birth. As a rule the syphilitic child does not reach adult life.

According to Davis, the deformities in the bones become
the most conspicuous between the ages of six and ten years.
At this time medical treatment in connection with protection
and support of the extremities, renders the prognosis more favorable. As age advances the bone hypertrophy diminishes
somewhat; but the shortening and curves in the long bones
usually remain as a permanent deformity.

Treatment. The treatment of congenital syphilis is conducted much as in the acquired disease by the alternation
of those remedies which build up the system, with others
which tend to directly overcome the dyscrasia. For the blood
pollution we have kalmia, stillingia, echinacea; to improve digestion and the blood making function, hydrastis, leptandra,
iris; to increase waste, the iodine compounds—iodide of potassium and acetate of potassium; for destructive bone disease
and defects of nutrition, lacto phosphate of lime, phosphate
of iron, and chloride of gold and soda. We aim to restore the
general health and avoid those remedies or methods of treatment which interfere with the natural powers of the system.
The disease runs a natural course, and the better the
general health the more certain and speedy the cure.

In congenital syphilis and rickets very much can be done
to prevent the deformity that usually arises from the weak-

ness of the bones. During the period in which the bones are soft and defective, the patient should not be allowed to bear much weight on the limbs. Let the act of learning to walk be delayed instead of hastened. It is usually the superimposed weight that produces the deformity and much care should be taken to prevent the consequent distortion from too early exercising.

SECTION III.
DEFORMITIES OF THE SPINE.

CHAPTER I.

POTT'S DISEASE.

Definition—Etiology—Tuberculosis, Heredity, Other Diseases, Traumatism, Pathology—Osteitis, Suppuration, Ossification, Angular Curvature, Paralysis, Muscular Rigidity; Symptoms—Premonitory, Muscular Stiffness, Attitude, Spinal Curvature, Pain, Paralysis, Abscess, Constitutional Disturbance, Permanent Deformity.

POTT'S DISEASE is a progressive inflammation of the spine, with partial or complete destruction of the bodies of the vertebræ, together with their intravertebral cartilages. It usually terminates in ankylosis with the characteristic posterior angular curvature.

It is also known as *Tuberculosis of the Spine, Caries or Osteitis of the Spine, Spondylitis, Antero-Posterior Curvature, Angular Curvature and Kyphosis.*

It occurs most frequently during childhood. The largest percentage of cases occurring from three to ten years of age. It may occur at any time of life. It appears about as often among boys as among girls.

Etiology. In the majority of cases the affection may be traced to some injury. (Taylor.) The traumatism may have been very slight, but if the history is obtained with care, in the majority of cases it will be found that at sometime, perhaps long before the development of any symptoms of Pott's disease, the child received a fall or was roughly handled, resulting in a traumatism of the spinal column, which was followed for a short time by sensitiveness in that region. In many cases, however, there is no history of injury.

Pott's disease very frequently occurs in children of poor families, and especially those who give a family history of tuberculosis. The disease will be greatly modified or exaggerated by the predisposing tendencies in the patient's sys-

tem. The disease is often associated with tubercular affections in other parts of the body, such as "white swellings" caries or necrosis of the bones, adenitis, phthisis, etc.

While some authors (Gibney and others), have found an hereditary tubercular taint in by far the largest percentage of cases, the latest investigations with the microscope, fail to reveal the presence of the bacillus tuberculosis in but a small number of the patients suffering from this affection.

Fig. 65.   From Pott's disease, showing deformity of the bones
of the thorax.   (Young.)

Cases of Pott's disease are reported following the exanthematous diseases of childhood, whooping cough and other depressing conditions incident to that period.

In the adult, any constitutional disease that has a tendency to damage the bones or joints predisposes to the disease, as syphilis and rheumatism.

Again, while these constitutional conditions are important as predisposing etiological factors, it is reasonable to suppose that most cases receive some injury that serves as the direct exciting cause; then with the predisposition present, the case readily runs a chronic course.

Pathology. The pathological process of Pott's disease is that of a destructive osteitis affecting the bodies of one or more vertebræ. The osteitis is usually tubercular in type, and follows the same course as osteitis occurring in cancellous bone tissue elsewhere in the body.

The condition seen on the examination of a section of a diseased vertebra with the naked eye, at an early stage of the disease, is that of a small hyperæmic spot in some part of the cancellous tissue, generally near the junction of the convex surface and the anterior border of the body of the vertebra. This spot grows larger and more red as the process extends, and finally the center becomes opaque and grayish, while a zone of hyperæmia surrounds it. If the tubercular bacilli are present, they may be found in the opaque or grayish substance. If this process extends, the opaque spot becomes larger, and finally degeneration of its center takes place. This process of destructive osteitis may continue until the body of the vertebra is destroyed and the surrounding tissues are involved.

The course of this destructive disease includes the circulation which supplies adjacent tissues with nourishment, thus causing a farther necrosis. By this disturbed nutrition large sequestra may be formed and the intravertebral cartilages be destroyed. This process may be going on in one or more vertebræ at the same time.

The destructive osteitis may terminate at any time by resolution and ossification, or may go on to suppuration and finally terminate by ossification.

The function of the vertebral column being principally that of weight-bearing, the pressure upon the body of each vertebra has a tendency to increase its destruction. If the body of a vertebra is becoming excavated by pressure and disease, it must give away slowly or suddenly to the superimposed

weight. These conditions being present, a tilting forward of that portion of the vertebral column is inevitable with the formation of the posterior angular curvature.

Mechanically speaking, the prominence in the back is produced by the bodies of the vertebræ softening and giving away and allowing the anterior side of the spine to drop together. The same mechanical change produces a shortening of the trunk, or, in other words, diminishes the patient's stature.
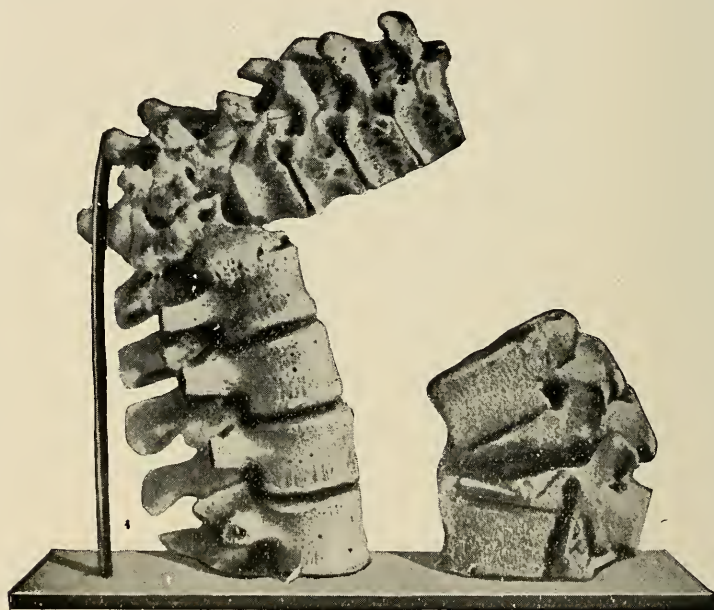
Fig. 66. From a specimen of Pott's disease, showing the absorption of the vertebral bodies. (Young.)

The spinal cord and its membranes may become involved. In certain cases, meningitis and myelitis are present opposite the seat of the disease, accompanied at times by paralysis more or less severe.

As a rule, the cord and nerves are affected by the inflammation and the deposits, and not from pressure due to a narrowing of the spinal canal. (Charcot, Michaud and others.) Other writers, (Elliott, Young) show how the paralysis may be due to compression induced by the direct pressure of

the vertebræ, obliteration of the canal, caseous deposits, sequestra or abscess.

In our opinion, cases vary greatly as to the pathology of the nerve trouble, at any rate, when the local inflammation improves the nerve disturbance improves.

Muscular rigidity in these cases is due, first; to the deep
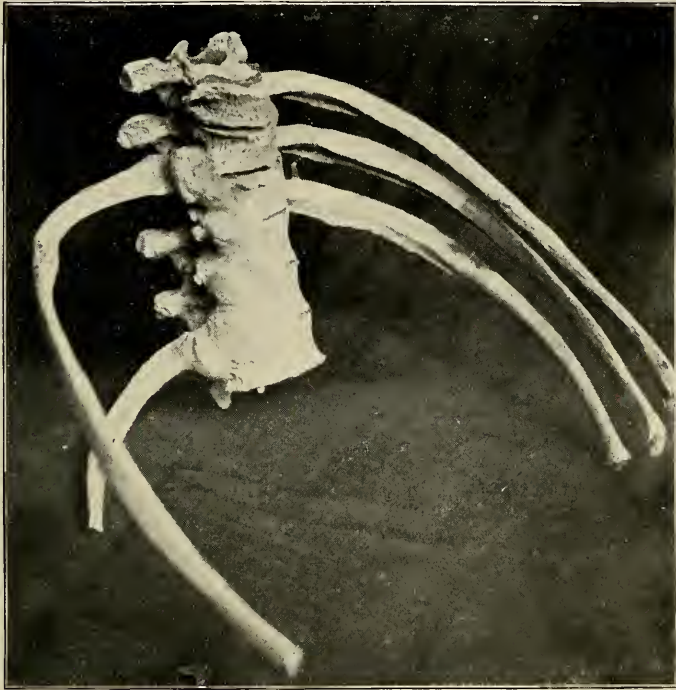
Fig. 67.   From a specimen of Pott's disease, showing the ankylosis of the bones.

irritation of the nerve which is reflexed to the muscles, causing spasmodic contraction, and second; to nature's involuntary effort to protect the diseased parts against irritation from flexion and friction.

Symptoms. The symptoms of Pott's disease present a great variation, because of the variety of structures that may be influenced by the condition. The location of the disease

along the spine, necessarily gives rise to spinal symptoms peculiar to its locality.
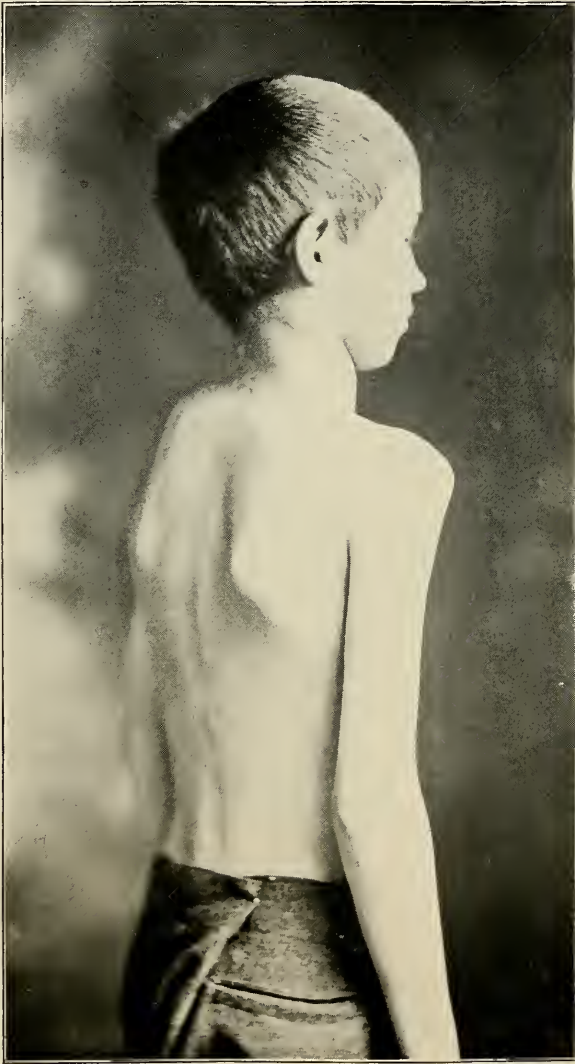
Fig. 68. Cervical Pott's disease.

Early in the affection there may be a period of premonitory symptoms; a condition between vigorous health and de-

bilitating sickness; a want of energy; an irritability and a lowering of all vital functions. This period may last for a few weeks or may be very short and unnoticed. After this period more definite symptoms assert themselves.

Muscular Stiffness. Among the first and most important symptoms is the stiffness or rigidity of the muscles that preside over that portion of the spine that is diseased. It is an early and persistent symptom. An unconscious or involuntary effort on the part of the patient to diminish jar, or to prevent friction at the situation of the affected vertebræ.

The muscular stiffness causes patients suffering with Pott's disease to assume characteristic attitudes and movements. The more severe the disease the more marked is the attitude. The characteristic attitude is according to the different part of the spine affected.

If the disease is in the cervical region, the most common attitude is that of wry-neck. In some cases it amounts to a marked kyphosis. The muscles of the neck are all more or less rigid so that there is very little motion between the cervical vertebræ. Usually those muscles lying nearest the site of the disease are contracted the most firmly, thus drawing the head to that side.

In upper dorsal Pott's disease, the neck is pushed forward, the chin elevated, the shoulders drawn up, while the spine below the disease is straight. Middle or lower dorsal Pott's disease, is varied slightly from the above in presenting a more pronounced fixation of the muscles along the seat of the disease, while the rigid spine gives a military attitude.

In lumbar Pott's disease, the strong muscular fixation gives the patient an attitude similar to that of an adult with a very large abdomen. The contraction of the psoas and iliacus muscles produces a marked lordosis, and at times a peculiar sliding gait of the patient. If a psoas abscess is forming, the spasmodic contraction of the psoas muscles may be well marked. As the abscess follows along the muscles it may so flex the thigh upon the abdomen that the patient cannot walk without a crutch, thus making the disease resemble very much that of hip-joint disease.

Spinal Curvature. The distinctive deformity in Pott's disease, is first; a prominence of the spinous processes of the vertebræ involved in the affection. It makes its appearance sometime during the advancement of the disease, and is more

Fig. 69.   Upper dorsal, Pott's disease.

pronounced in the dorsal, than in the cervical or lumbar regions. The deformity may not appear when the disease comes on late in life. During the active stages of the disease, there is an increase of this prominence until an antero-posterior curve or angle is formed.

A slight lateral deviation is sometimes noticed, and when present is an index that the vertebræ are diseased mostly on one side; a tilting may take place laterally, as well as the muscular spasm being mostly one-sided. As the primary angle or curve increases, secondary curves are formed. Some times a primary curve in the dorsal region, as a kyphosis, causes a secondary curve in the lumbar region, or a marked lordosis.

Fig. 70. Dorsal, Pott's disease.

It cannot be said that the more active the disease, the greater the deformity. Generally speaking, the case that is not treated and runs a slow and protracted course, results in the greatest deformity. In cases left to themselves, the tendency is for the deformity to increase until a spontaneous cure results or death ensues. Where the disease is dorsal, an extreme degree of deformity may result. There is a settling downward of the sternum and ribs until the trunk is much shortened.

Pain. In the greatest number of cases of Pott's disease the pain is a distressing symptom. The patient seldom complains of pain in the spine or at the seat of the disease, but at the peripheral termination of those nerves that pass from the spine at the seat of the disease.

In cervical Pott's disease, the pain is in the neck, throat or upper extremities; there is sometimes a choking feeling resulting from it. In dorsal Pott's disease it is referred to the

Fig. 71.   Lumbar, Pott's disease.

chest; intercostal neuralgia, coughing and palpitation of the heart may result. In lumbar Pott's disease the pain is felt in the abdomen and lower extremities; colicky pains, irritation of the bladder, and pains shooting down the thighs, are complained of.

The pain is usually subacute, at times becoming intense and lancinating with intense hyperæsthesia. It is spasmodic or intermittent as a rule, varying from slight irritation, to the

severe form. It is more severe at night. In some cases " night cries " are present. Possibly the patient that suffers so intensely at night may be comfortably walking around in the day time.

With some patients, the disease seems to run a slow course without pain, while others are troubled with excruciating attacks. It may be only in periods constituting acute attacks and subsiding after rest. It is to be expected that the pain will diminish by efficient treatment. As a rule the variation in the degree of pain may be considered an index of the increase or decrease in the activity of the disease.

Paralysis. The paralysis of the lower extremities, which so frequently accompanies and complicates Pott's disease, is easy to understand when we consider the nearness of the spinal cord and its membranes to the diseased area. Paralysis occurs more frequently in those cases which are not treated and where the disease is in the upper dorsal region.

The symptoms of paralysis are those of myelitis— gradual loss of power, increased reflexes, exaggerated patellar reflex, and increased ankle clonus in the early stages, followed by complete loss of power, contracture of the muscles, atrophy of the paralyzed muscles, and loss of sensation in the later stages. In severe cases, the paralysis of the sphincters is a late symptom. In lumbar Pott's disease there may be retention of feces and urine for a considerable time before relaxation of the sphincters is established.

Paralysis does not occur in all cases. Many children with Pott's disease are helpless from weakness and not from paralysis. It is rarely an early symptom. In most cases, when it exists, it appears during the third year. (Gibney.) The duration of the paralysis is not over three years. (Taylor and Lovitt.) A recurrence of paralysis has been noticed. On an average it lasts only about one year. Its tendency is toward recovery, and good results are much hastened by efficient treatment.

Abscess. Suppuration and abscess forms a distressing complication in many cases of Pott's disease. It usually has its origin about the bodies of the vertebræ and accumulates

in front of them, projects into the cavities of the thorax and abdomen; surrounded by the lungs and intestines, close to the large vessels and the œsophagus. It seems wonderful that the formation of abscess in Pott's disease does not more frequently destroy the patient's life.

The abscess is usually tubercular—a cold abscess. The accumulation of pus takes place slowly, and gradually follows the line of least resistance. The layers of fascia in most cases, protect the large cavities from invasion. The pus generally extends along the sheaths of the muscles, and comes to the surface at some point distant from its origin. The pus may burrow in almost any direction, but the usual situations at which these abscesses point at the surface, has given them the names of *retropharyngeal, lumbar, iliac and psoas abscess.*

Psoas abscess is the most common. It usually arises from dorsal Pott's disease. Shaw describes it as follows: " When the abscess is connected with diseased dorsal vertebræ, it encounters in its descent, the diaphragm. But the barrier is overcome by a peculiar process. As the abscess comes in contact with the diaphragm and compresses it, adhesive inflammation is set up in the respective surfaces. The consequence is that they become united over a considerable area. An opening is next formed by absorption within the boundaries of the adhering structures; the abscess then protrudes; and extravasations of pus at the margins is prevented from taking place by the firm union of the parts encircling the opening. The abscess comes into relation with the heads of the psoas muscle. As it travels downward, it is prevented from enlarging in the fore part, by the resistance from the ligamentum arcuatum, and at the back, by that of the spine and the lowest rib; hence it forces its way in the line of the psoas muscle." It follows more on the outer than on the inner side of the muscle. It finally reaches Poupart's ligament and may bulge in the groin, or may follow to the insertion of the muscle and point below the groin. There are, however, many variations from the above course.

Lumbar abscess from Pott's disease is usually the out-

come of disease of the lumbar vertebræ. It appears as a swelling on one side or the other and at the outer border of the quadratus lumborum muscle.

Iliac abscess is from the iliac fossa and may be associated with either psoas abscess or dorso-lumbar Pott's disease.

Retropharyngeal abscess is the usual outcome of suppurative cervical Pott's disease, where the pus bulges into the pharynx and, dissecting its way, may burst into the mouth, pharynx, œsophagus and, rarely, into the lungs.

The contents of the abscesses vary. Usually they contain sero-purulent fluid, with caseous masses, and degenerated tissue. The streptococus pyogenes can be found. It is very rarely that the tubercular bacilli can be found in the discharges. Shreds and flakes of pus with spiculæ are often seen. As a rule abscesses discharge for an indefinite length of time.

Constitutional Disturbance. A more profound impression is produced upon the general constitution by Pott's disease than by other joint or bone diseases. Children suffering from the disease are noticeably retarded in growth; and, from shortening of the trunk, become dwarfed. The extremities seem abnormally long for the body, and the head unusually large. They usually acquire a fretful and capricious disposition. They are delicate, take cold easily, and are liable to attacks of pneumonia.

Patients with extreme deformity, where the trunk is shortened, seem to suffer from indigestion, asthma and heart disease.

The temperature in Pott's disease is, as a rule, slightly above normal; usually ranging from 99° in the morning to 101° in the evening. If an abscess is forming there is more variation in temperature. There may be general pyæmic symptoms—chills, fever, loss of appetite, cold clammy sweats, restlessness and a general hectic appearance.

Permanent Deformity. After a cure has resulted, and ankylosis of the bodies of the vertebræ has taken place, more or less permanent deformity is the result. The patient usually acquires the normal degree of health, and may pass through life without much difficulty.

Cases with extensive deformity, suffer more or less weakness and functional irritation of the internal organs, because of the diminished capacity of the thoracic and abdominal cavities.

CHAPTER II.

Diagnosis. Little trouble is experienced in diagnosing
Pott's disease where it is well advanced. The posterior an-
gular deformity of the spine, with shortening of the trunk,
the history of a protracted sickness, the constitutional dis-
turbance, with possibly paralysis and an abscess, is suffi-
cient to establish the nature of the trouble.

An early diagnosis is often difficult. The importance of
an early recognition of the disease cannot be over estimated.
To this end an examination should be most thorough and
painstaking. The earliest evidence of the disease revealed
by the examination may well be considered under four heads:
first, the peculiar attitude of the patient; *second*, muscular
stiffness; *third*, the pain and irritation; *fourth*, early de-
formity.

The Peculiar Attitude. The child should be placed upon
the floor and made to walk about by himself. This pro-
ceeding will reveal the peculiar attitude, gait, or position
which will not be evident in any other way. There is an un-
conscious effort on the part of the patient to prevent jar or
any increase of pressure upon the affected vertebræ. There
is usually noticed some effort toward relieving the spine from
the pressure naturally imposed upon it.

In cervical Pott's disease, the wry-neck is readily noticed;
and, if the child is left to himself, he will sometimes be seen to
assume a squatting position, with his chin resting in his
hands.

In dorsal Pott's disease, the military attitude is observed. As the child walks about the room, instead of passing across the floor, he will pass around the wall, or from one chair to another, relieving part of the spinal pressure by bearing his weight on his hands as he comes near any convenient article of furniture.

Fig. 72.   Occasional attitude of rest in cervical Pott's disease.

In either dorsal or lumbar Pott's disease, the patient may be seen to rest the spine by supporting the weight with his hands bearing on his knees.   It will be noticed that he tires out quickly, and wishes to lie down.   If some article is placed on

the floor and the patient stoops to pick it up, he will keep
the spine erect, lowering himself to the floor by bending the
knees.

Fig. 73.   Attitude of rest in dorsal Pott's disease.

Muscular Stiffness. One of the very earliest diagnostic
signs in Pott's disease is the muscular stiffness of the

spine. To recognize this, it is necessary to make a comparison between the normal flexibility of the spine and that of the patient under examination.

The patient should be divested of his clothing, and placed in a prone position upon the table. The surgeon places his left palm upon, and fixes the pelvis, and grasping the feet with his right hand, an attempt is made to raise the thighs. Normally the spine can be bent to a marked degree, but if the Pott's disease is in the lower dorsal or lumbar region the whole trunk raises as if there was no spinal flexion.

In adults, the examination must be modified to that of voluntary movements on the part of the patient, mostly as a substitute for passive manipulation.

If the disease is confined to a very small area, the muscular stiffness is more difficult to detect. As a rule, however, if an attempt is made to produce the normal movements in the spine the stiffness will be observed. This is true in whatever part of the spine the disease is situated.

Pain and Irritation. Pain is not always present in Pott's disease. When present it is generally referred to the head, shoulders, chest, abdomen, or the thighs, rather than to the back. It is usually spasmodic in character, varying from entire absence to irritation, or to severe cramps.

The pain and irritation is increased or excited by jarring, and sometimes by careful handling, and by any act that increases the pressure between the bodies of the vertebræ. Percussion over the spine may or may not elicit tenderness.

A valuable test in determining deep seated sensitiveness is the use of the electric current passed through the diseased structures. Preferably a galvanic current is used, of sufficient strength to feel comfortable to the patient, with wet sponges placed on the body in different places. As one of the sponges is moved over the diseased tissues, and the current passes through them, there will be a sudden flinching or spasm of the muscles.

The Early Deformity. An early recognition of the deformity is not easy. In young and fat children the spinous processes cannot be readily felt, and furthermore, normal

variation of the spinous processes may exist. In the cervical
and lumbar regions the bones are covered by the thick and
overlying muscles which prevent an early recognition of the
disease.

Fig. 74.   Military attitude seen in some cases of Pott's disease.

In Pott's disease the projecting spinous processes seem
decidedly too long to conform to the character of the others.
Where such projecting exist with the other symptoms, it
should be regarded as presumptive evidence of the affection.
The deformity is often absent in the adult.

Differential Diagnosis. The principal troubles that need to be differentiated from early Pott's disease are wry-neck lateral curvature, hip-joint disease, rickets, and hyperæsthetic spine.

Wry-neck is a symptom of cervical Pott's disease, but it differs, however, from true wry-neck. True wry-neck is a muscular contraction, involving certain muscles of the neck, the other muscles being unaffected. The movements of the head are free in all directions excepting that which is allowed by the contracted muscles, while in Pott's disease all the muscles assist in fixing the head, and the deep muscles tend to fix it most firmly.

Lateral curvature of the spine is not an inflammatory trouble, but is simply a lateral deviation of the spinal column due to weakness. In true lateral curvature of the spine there is a very gradual development without pain, muscular stiffness, or constitutional disturbance, all of which are diagnostic signs in Pott's disease. The lateral deviation which sometimes is present in Pott's disease, is not so much characterized by rotation of the bodies of the vertebræ and by rotation of the ribs, as is seen in true rotary lateral curvature.[1]

Hip-joint disease might, under certain conditions, be mistaken for lumbar Pott's disease. In acute cases there is stiffness of the lumbar and psoas muscles, nearly alike in both diseases, and any attempt at flexion or extension of the thigh, carries the pelvis and lower spine with it.

The test which will decide the matter is to attempt abduction and adduction at the hip. These movements are possible in Pott's disease, but impossible in hip disease. In hip disease there is restricted motion in all directions of the normal movements of the hip; while in Pott's disease the stiffness of the back and psoas muscles are most pronounced.

Rhachitic spine bears a striking resemblance to the deformity developing in early Pott's disease. It occurs, however, in young children who present more or less marked signs of general rickets. Muscular stiffness is not at all marked in rhachitic spine, unless the bodies of the vertebræ are so soft that they are yielding to the superimposed press-

ure and then the condition becomes one identical with that of Pott's disease. It is necessary in some of these cases to make several examinations to determine as to a positive diagnosis.

Hyperæsthetic spine is liable in some cases to mislead in the diagnosis. When it is remembered that in Pott's disease there is no especial sensitiveness of the skin over the spine, or pain on pressure over the back, it will be comparatively easy to make the differentiation.

Hyperæsthetic spine usually occurs in adults and is often present in people who have been in railway accidents. It is sometimes called " railway spine." In it the principal symptoms of Pott's disease are absent.

Prognosis. Although many cases of Pott's disease have terminated fatally, the tendency is toward recovery. Even untreated cases tend toward a spontaneous cure after running a course of from four to six years.

There is always a serious deformity remaining after spontaneous cure has taken place, which might have been prevented had proper treatment been instituted in time. In few affections does careful treatment avail so much as it does in Pott's disease. The greatest good is accomplished by treatment when an early diagnosis is made, and mechanical measures taken before the posterior angular curvature of the spine has asserted itself. When once the deformity has taken place it may be diminished somewhat by treatment, but it never entirely disappears.

The prognosis is rendered more unfavorable by the occurrence of an abscess. When suppuration is established it usually continues for a long time and the secondary dangers from bacteria are great. The discharge of pus usually ceases when the bodies of the vertebræ have become ankylosed and the sinuses have healed. A fatal termination may ensue from exhaustive suppuration, pyæmia, or general tuberculosis.

The time necessary to produce a cure, cannot be exactly stated, on account of the great variety of conditions that may attend the case. We might say, however, that generally the

earlier the treatment is begun, and the more efficiently it is carried out, the sooner a cure will be accomplished.

Inasmuch as these cases come under treatment when well advanced, it is safe to predict for them a course of treatment which shall last for two or three years. It is well to continue treatment until sufficient time has passed, so that there will be no danger of a relapse. Often the course of treatment is interrupted or discontinued before the bodies of the vertebræ have become ankylosed and serious recurrence of the disease has taken place.

CHAPTER III.

POTT'S DISEASE (CONCLUDED).

Treatment—Principles, Indications, Recumbency, Appliances, Operative
Treatment, Constitutional Treatment.

Treatment. The principles of treatment of Pott's disease
are simple, but their application is not always easy to carry
out. The principles upon which to base the treatment are sug-
gested to the observer by the acts of the child. His appear-
ance, manœuvres and inclination give the indications which
are to be met by specific treatment.

Every act indicates that the diseased area should be
protected against irritation from friction and pressure. The
presence of an abscess, or necrotic tissue, demands prompt
surgical interference. The emaciated and hectic appearance
suggests that the patient have the best hygenic and sanitary
advantages, and all this to be enforced by proper medication.

For convenience, the methods of treatment may be con-
sidered under four headings. *First,* the treatment by re-
cumbency; *second,* the treatment by supportive mechanical
appliances or corsets; *third,* operative treatment; and *fourth*
the general indications to be met by proper constitutional
treatment.

Recumbency. If a child lies on a level surface the natural
curves of the spine are removed and it becomes straight, and
all weight and pressure from the upper part of the body is re-
moved. In this way recumbency fulfills nicely this indication
in the treatment.

If, however, the surface upon which he lies is a soft bed,
so that it sags under the back, or the child lies on the side,
or is allowed to sit up or change positions other than keeping
the spine straight, this happy effect is lost. The patient

should lie on his back, or possibly on his face. The bed must be flat and no pillows should be used.

If the patient is restless or unruly, he can be prevented from sitting up or turning over by soft cloth straps, or bandages placed across the bed and over the shoulders, and secured at the sides of the bed. Other straps can be used at the hips to keep the pelvis from moving.

It is difficult to secure sufficient fixation in the recumbent treatment without the use of some form of fixation frame. The wire curass of Sayer answered this purpose admirably well. A less expensive apparatus is found in the bed-frame. It is made from four pieces of common gas pipe (or common iron) fastened together, making a rectangular frame which is large enough for the patient to lie on. This is covered
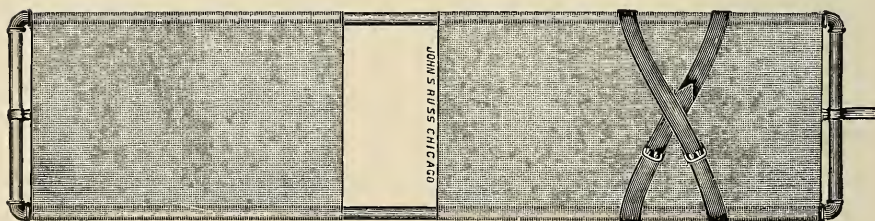
Fig. 75. Bed-frame used in the treatment of Pott's disease.

tightly with canvas and made tense. The frame is placed upon the bed and the patient lies upon it as comfortably as upon the ordinary mattress. It is also convenient for handling the patient as by it he can be lifted and carried about easily. An opening should be made in the canvas in the region of the buttock so that the bed pan can be used.

The patient can be tied or bandaged to the bed-frame if he is unruly. An extension adjustment can be placed on the ends of the frame so as to produce the required amount of extension of the spine. In some severe cases, fixation of the trunk may be further secured by using sand-bags or a plaster of Paris cast in connection with the frame. Sometimes the use of pads placed under the back, to press the spine forward, is of advantage.

Recumbency is the best method for the treatment of all

acute or severe cases, and should be continued until an appliance can be worn with safety.

Fig. 76.   Case suspended for the application of a plaster of Paris jacket.

Appliances, Corsets and Braces. The most ready method of treatment of Pott's disease is by the plaster of Paris jacket.

The advantages of this method are its ready applicability, its cheapness, and the fact that it places within the reach of every practitioner and patient an efficient means of treatment.

The plaster jacket is especially adaptable to cases where the symptoms are not very severe, or those which are passing

Fig. 77. Plaster of Paris jacket for spinal disease, with lacing.

through the protracted period of convalescence. Some skill is required in the application of the jacket. If applied too loosely, or if made too short to act as a firm support for the upper body weight, or so that it crumbles and breaks, it will do harm rather than good. In applying a plaster jacket the patient should have extension applied to the spine so as to correct

the curves as much as practicable, for by so doing the de-
formity is diminished and the irritation from pressure will be
relieved. The extension should not be sufficient to produce
pain.

The best methods of applying the jacket is by the use
of the bed-frame or Sayre's suspension apparatus, Fig. 76.
Plaster of Paris bandages, prepared in the usual way, are
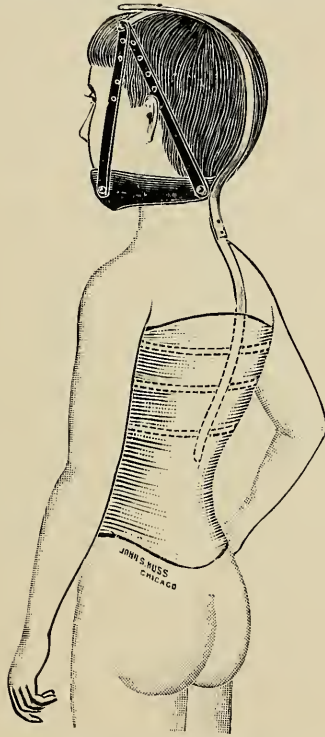
Fig. 78.   Jury mast attached to a plaster of Paris jacket
for cervical Pott's disease.

wound around the trunk, with the patient kept in the
corrected position until the plaster has become hard. Some-
times strips of tin are inserted within the plaster to strengthen
the jacket and prevent its breaking.

The jacket should be applied as near the skin as possible,
usually on an under vest that fits the body without wrinkles.
The best freshly prepared plaster bandages must be used and

during their application, the plaster must be well rubbed into the coarse meshes of the cloth. If the jacket does not fit well or any difficulty from it should arise, it must be removed and a new one applied. The skillful application and frequent renewal of the plaster jacket promises relief to the patient.

Plaster jackets can be sawed through the front and lacing hooks fastened to the sides of the cut, and the jacket,
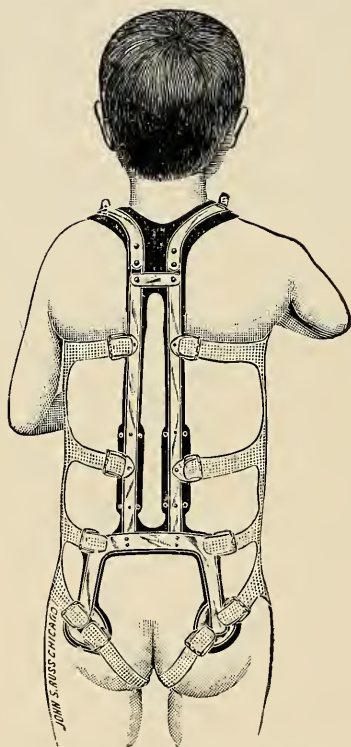
Fig. 79.   Antero-posterior spinal brace.

like a corset, be removed and reapplied at pleasure. This, however, should only be done in convalescent cases.

Other material, such as leather, paper, wood or wire is sometimes used as a substitute for the plaster of Paris jacket. These can be shaped and nicely completed upon a cast taken from a plaster jacket used as a mold. They are more expensive and hardly more serviceable than the plaster of Paris.

If Pott's disease is situated in the cervical or high dorsal
region, the jacket is used simply as a base for the support of
some form of head extension. The most common of these is
the jury mast, which consists of a bent steel rod serving as a
support for a head-sling. Instead of the jury mast and jacket,
an apparatus can sometimes be used about the neck, acting
so that the weight of the head will rest upon the shoulders.
Thomas' collar is a contrivance of this kind made of leather
or rubber.
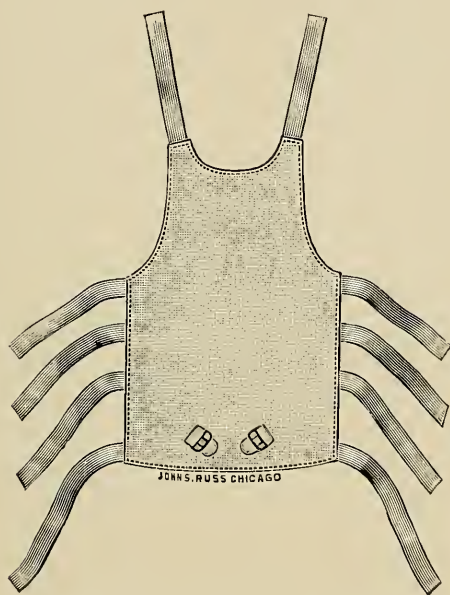
Fig. 80. The apron for the antero-posterior spinal brace.

The treatment by means of spinal braces is not at the
present time looked upon with as much favor as formerly.
Surgeons find that the relief from braces is generally very in-
effectual, and in order to overcome the defects the patient
must too often be left to the instrument maker, whose object
is mostly to sell a complicated appliance to the patient.

With the proper experience and skill as to detail in the
manufacturing and fitting of braces, a patient with Pott's
disease can derive much benefit from them. The spine brace
acts mostly on the principle of a lever; the fulcrum being in

the region of the diseased part of the spinal column, the weight at the waist band, and the power applied above to pull the shoulders back as far as possible.

The most that can be expected of the brace is to prevent the bending of the spine forward in dorsal Pott's disease and to support a head rest for cervical disease. As a rule the more simple the construction of the brace, the more it can be depended upon, if it answers the purpose at all.

The most simple, and probably the best of all these braces is the antero-posterior support. The brace consists of a strong steel support which is fitted to the back on each side of the spine, while the patient is lying on his face. The patient is secured to this by an apron carefully fitted in front and secured to the brace behind by straps and buckles. It is to be applied when the patient is recumbent, and when he arises it forms the support.

An attachment can be made for the head-sling in cervical and upper dorsal disease. All braces must be watched and whenever there is any change of shape and size of the patient the apparatus must be changed accordingly. Excavation can sometimes be prevented by proper padding.

With all kinds of support the patients may at first complain, but if the apparatus fits properly they soon become accustomed to it.

Operative Treatment. Abscesses constitute the most formidable complications for which operative treatment is required. If a diagnosis of abscess can be made early, even before it has reached the surface, and it can be aspirated, washed out with an antiseptic solution, and thoroughly injected with iodoform emulsion, the caries will be benefited, and the abscess probably cured. Usually several injections are required and this should be done in connection with the recumbency treatment. The efficiency of iodoform emulsion injection for cold abscess, is too well known to need farther comment. In a certain number of cases the tendency is toward protracted suppuration, and, if the abscess can be reached with the knife and thoroughly drained, it should be done. Antiseptic precaution must be observed.

The opening must be made where the pus collects under the skin; and as near the source of the abscess as possible. Retropharyngeal abscess is opened through the mouth. Psoas and iliac abscesses should be opened below—where they point; and also in the back, in the space between the ribs and the crest of the ilium. Lumbar abscess is also opened in this space.

To reach the abscess in the lumbar region it is sometimes necessary to cut through, or at the border of the quadratus lumborum muscle, as the pus sinus lies very deep, about the heads of the psoas muscle. If spiculæ be encountered they can be removed through this opening. In some cases of lumbar or lower dorsal caries the curette may be used to advantage; scraping and washing away the necrotic tissue as far as possible.

If the disease is in the dorsal region, some surgeons (Hartman, Vincent, Schaeffer and others), have advised an incision down to the tips of the transverse processes of the affected vertebræ; dividing the ribs at the tuberosities, and then the transverse processes. The bones are removed by blunt dissection. This opening allows the bodies of the vertebræ to be reached at the side, when drainage can be used if deemed necessary.

To reach the cervical vertebræ from without, an incision is made on the posterior border of the sterno-mastoid muscle, the length of the incision depending upon the depth of the bones. The superficial veins and nerves are to be avoided if possible. The space bounded by the splenius, omo-hyoid, and posterior scalenus muscles is reached. The longus colli is to be dissected through. Great care must be taken not to wound the vertebral arteries and nerves. Through this opening the bone can be examined and abscess from cervical caries can be drained.

The operation in the cervical and dorsal region is considerably complicated and not followed by the best results. In the lumbar region the operation will be found to meet the indications more readily and more safely.

The operation of *laminectomy* is sometimes performed to

relieve the pressure upon the spinal cord. It consists in cutting down on the vertebræ through a median incision. The lamina and spinous processes are to be laid bare. The periosteum is pushed away, and the lamina cut through on both sides of the spinous processes, care being taken not to wound the dura or the nerves as they emerge from the spinal foramina.

The lamina of one or more vertebræ may be removed, the dura inspected and the contents of the spinal canal determined. The condition of the bodies of the vertebræ can be determined by exploring through the canal by means of a probe, pushing the cord to one side. The muscles and ligaments are to be sutured, leaving small drainage for a few days. A bed frame is valuable for some months after this operation. Laminectomy is indicated principally in very severe cases when the disease is complicated by paralysis, and after other treatment has been diligently tried with no benefit.

Constitutional Treatment. Throughout the whole course of the disease the general indications should be carefully met. Generally the indications point to reconstructive agents such as the hypophosphites of lime and soda, iron, cod-liver oil, etc. Great care should be exercised as to diet, selecting nutritious food, and attending to the general functions of the body. At times bitter tonics are indicated, and at others, digestives. At all times the functions of elimination should be watched, and if found deficient they should be properly treated. Good hygenic surroundings are of the greatest importance, as by this means much less medication will be found necessary. Fresh air, sunlight and sufficient exercise, are nature's own remedial agents, and should be administered according to the patients ability to take them.

The proper clothing, baths, massage and electricity are important adjuvants. Treatment over the spine which has a tendency to equalize the capillary circulation, and supply reparative material to the diseased area, as well as to assist in the removal of waste, is of great value. Static electricity is valuable in this respect.

CHAPTER IV.

LATERAL CURVATURE OF THE SPINE.

Definition—Etiology—Weakness, Habitual Faulty Position, Paralysis, Rhachitis, Empyema ; Pathology—Primary and Secondary Curves, Anatomical Changes, Symptoms—Unequal Movements, Change in Outline of Body, Constitutional Disturbance.

Lateral curvature of the spine, is a permanent lateral deviation of the spinal column, or a part of it, from its physiological direction. It is also known as *Rotary Lateral Curvature* and *Scoliosis.*

Lateral curvature is a common deformity, developing usually in growing children. Mild cases are often entirely overlooked until the patient reaches maturity and begins to wear tailor made clothing. It may develop in the youth or in infancy. It occurs more frequently among girls than among boys. Cases exist in wealthy families as well as among the poor.

Etiology. Weakness is the most common cause of lateral curvature. On account of the physiological curves in the spine, it becomes necessary for considerable force to be exerted by the muscles and ligaments to hold the trunk in the erect position. A weakness of the structures holding the spine erect, causes the upper part of the body to sag and the spine to assume more than the natural curves. It is usual for the strength of one side of the body to exceed that of the other side. It seems easy to understand how the superimposed weight in bearing down upon a spinal column, thus unequally supported, would induce lateral curvatures.

The weakness is sometimes the result of a rapid growing period, instead of that of a debilitating sickness. At other times lateral curvature is seen to develop in children who are always more or less delicate and weakly.

Habitual faulty positions are considered as a common cause of lateral curvature. Infants are often kept too constantly in the same position, either sitting or lying, and a lateral curvature may develop as the result. Sitting continually in one position at the desk while at school may be considered an etiological factor. Any faulty position too con-

Fig. 81.   Right lateral curvature.   From a plaster cast.

stantly assumed may contribute to the deformity, as that which is assumed during writing, playing musical instruments, working, etc.

Lateral curvature developing from a bad habit, is sometimes called *habit scoliosis*, while that which develops from positions assumed during occupations, is called *professional*

scoliosis. Static scoliosis is a term applied to that form due to inequality of the length of the legs. The static variety comes usually from cases where there is a marked tilting of the pelvis from a short lower extremity or a deformity which alters the normal relation of the pelvis to the spine.

Paralysis of the muscles of one side of the body is usually followed by more or less lateral curvature. When the muscles
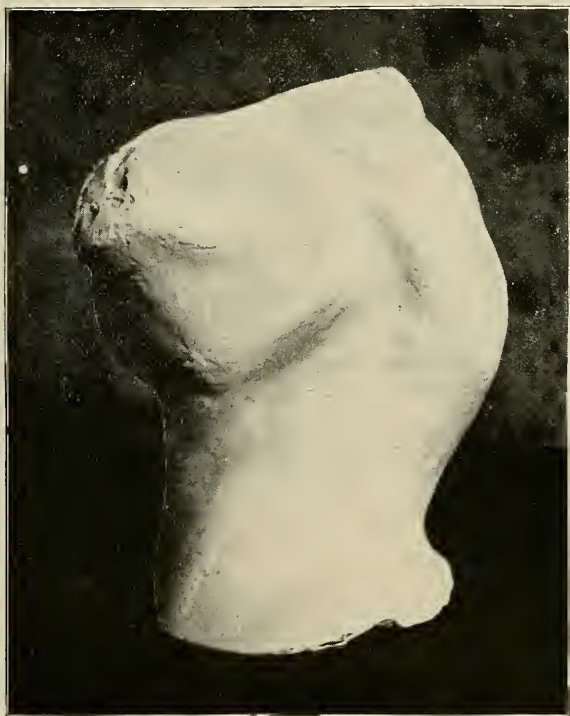
Fig. 82. Right lateral curvature. From a plaster cast.

of the back are only partly paralized, the weakness is evident from the faulty positions assumed by the patient and the development of lateral curvature is the result. This form of lateral curvature is most commonly developed after infantile paralysis. It is not often noticed until the patient is growing and is gradually recovering from the paralysis.

Rickets often produces such a weakness of the attach-

ments of the muscles and ligaments that lateral curvature results. Children that have rickets, and then assume faulty positions as described above, are apt to develop lateral curvature.

Of the pathological conditions which are liable to produce lateral curvature, the most common is that of empyema. The protracted period, during which time the side affected by the empyema is held firmly, while the muscles on the other side

Fig. 83.   Left lateral curvature, caused by empyema.
From a plaster cast.

are carrying on the act of respiration, is considered sufficient cause for the lateral curvature.

In children, lateral curvature always occurs after the resection of the ribs for empyema.

Traumatism or inflammatory conditions of various kinds about the trunk, are liable to be followed by lateral curvature.

To sum up the etiological factors and group them, we might say that there are but two general classes:

First. Weakness induced by debility, faulty habits, rickets or paralysis.

Second. Where the equilibrium of the spine is disturbed by altered pelvis, traumatism, or inflammatory conditions about the trunk.

Pathology. The pathological changes, that take place in lateral curvature, are due to the misdirected power exerted on those structures which support the thorax and upper body weight.

The bones of the spine and the ribs yield under the weakened support, and torsion, and curvature of the vertebræ results. The superimposed body weight adds to the tendency to torsion, and the change of pressure produces change in the shape of the bones. The changes vary according to the portion of the spine most affected and the degree to which the deformity has developed. If the lateral curvature be developed from weakness, the primary and most pronounced curve is in the dorsal region. Secondary curves will be found in the lumbar and cervical regions. If, on the other hand, the equilibrium is disturbed by altered pelvis, then the primary curve is in the lumbar region, and the secondary curve is in the dorsal region.

Where the deformity is only slight and of short duration, no pathological changes have taken place. If the deformity is well developed, and has existed for some time, then the altered pressures will have produced an alteration in the shape of the structures involved in the deformity; namely, the bones, cartilages, ligaments and muscles.

In lateral curvature the pressure from above is borne upon the spine nearly in a vertical line, and that portion of the bodies of the vertebræ toward the concave side, receives the greatest pressure, and by it the shape of the bodies are gradually changed by the process of pressure-atrophy. This is also true of the intravertebral cartilages. They become wedge shaped, with the thin portion of the wedge toward the concavity of the curve. In order that the spine may accommo-

date itself to this pressure, the unsupported vertebræ rotate on the axis of the spine, with their bodies toward the convexity of the curve, and the spinous processes toward the concavity.
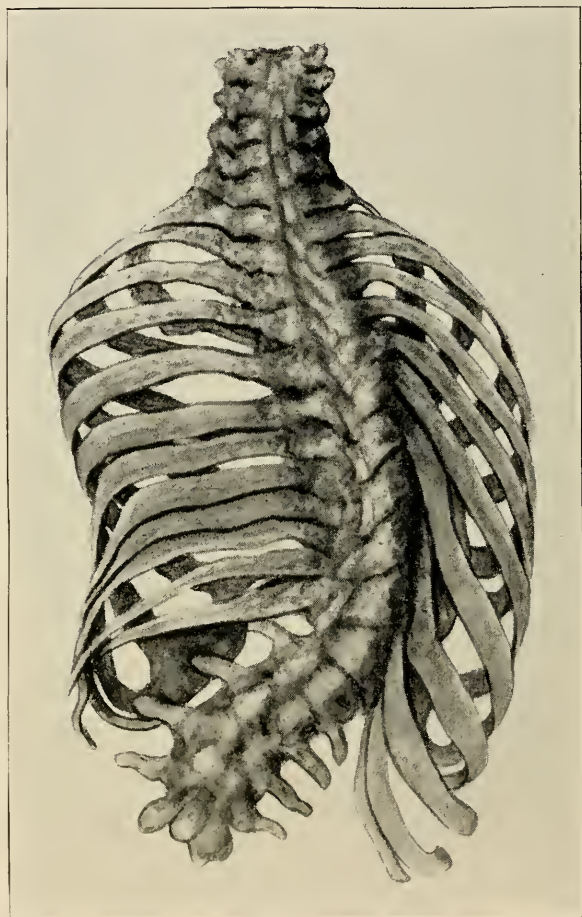
Fig. 84. A specimen from a case of lateral curvature, back view.

The rotation or torsion of the vertebræ is equally true of any lateral curving of the spine—primary or secondary. The greater the lateral curve the greater the torsion.

The ribs are likewise rotated, as they must follow the

source of their attachment. On the convexed side of the curve their angle is much more acute than normal, while on the concave side they are depressed, widely separated from each other, and the angle is more obtuse than normal.
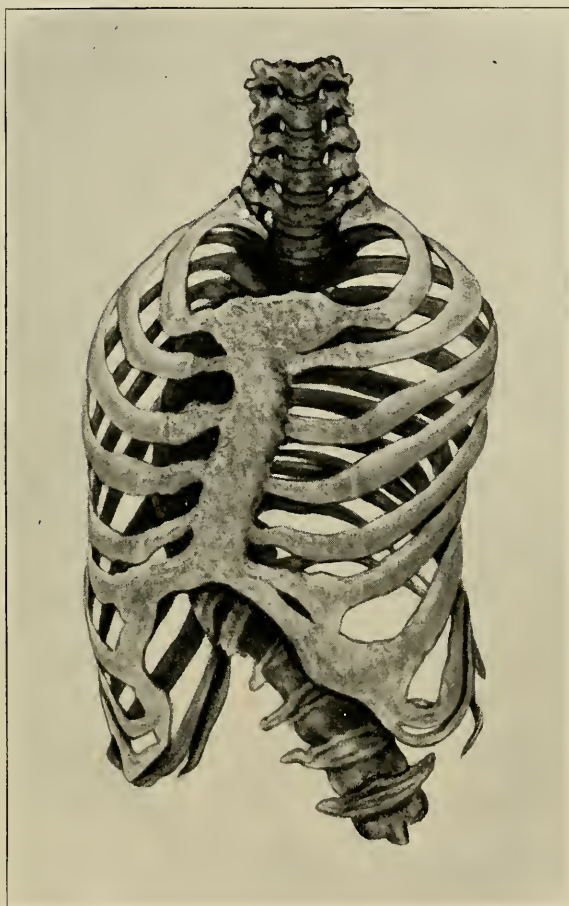
Fig. 85.   Same specimen as Fig. 84, front view.

The ligaments and muscles are relaxed and atrophied on the convex side, while on the concave side they are more or less contracted, and are stronger than on the other. The difference in the muscular power of the two sides is evident in

severe dorsal curvature, as respiration is affected principally by the muscles upon the concave side.

Fig. 86. From a severe case of right lateral curvature.

The effect of lateral curvature is to cause displacement of the thoracic and abdominal organs. The lungs are com-

pressed on the convex side, and given more room on the con-
cave side. The heart, in severe cases, may be displaced,
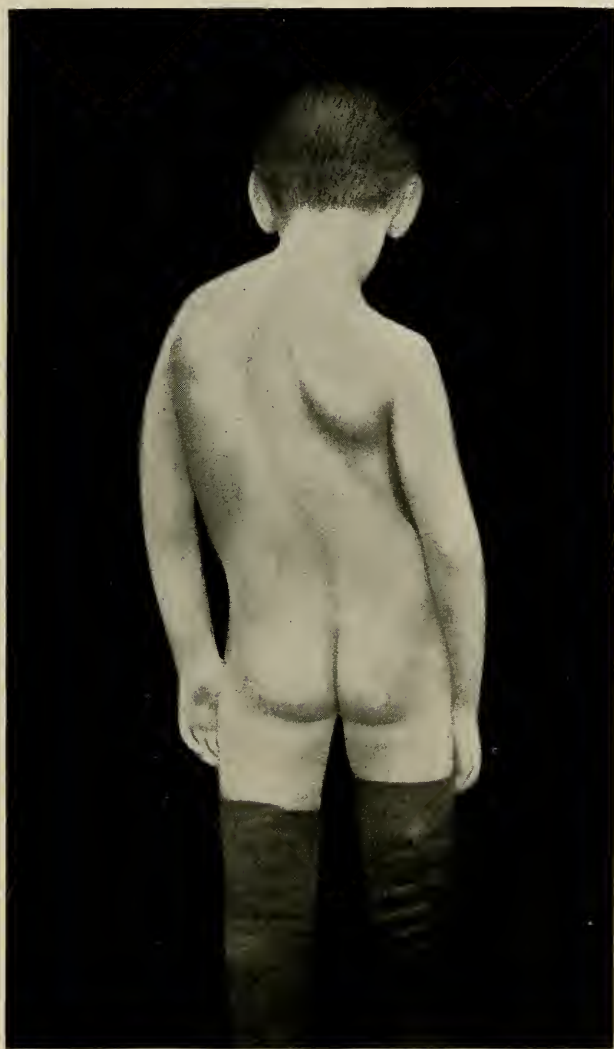
Fig. 87. A case of left lateral curvature.

even to the right side, or at least toward the concavity. The
stomach, intestines and liver are displaced downward, and

the spleen and kidney upon the convex side are usually smaller than normal.

Fig. 88. Showing front view of a case of lateral curvature.

Symptoms. Lateral curvature of the spine usually develops so gradually during the growing period, that its symp-

toms are unnoticed until it has existed for a considerable length of time. The deformity is often discovered by accident by the mother, or dressmaker, at about the age of puberty.

In the earliest stages the patient suffers no inconvenience, and in children, the faulty position and fatigue is overlooked. Many times when the deformity is first observed by the parents they are not alarmed by it, as they say, " the child has never been sick." If the patient's actions are carefully watched, it will be observed that the gait and movements are unequal on the opposite sides of the body. The dorsal curve influences principally the movements of the shoulders and arms; the cervical curve, the movements of the head; while the lumbar curve influences the lower extremities.

Upon one side the shoulder and especially the scapula, will appear more prominent, The distance from the axilla to the hip is shorter, and the curve at the waist deeper, than on the opposite side. If the patient is a fat subject the early recognition of these symptoms is difficult, but when the deformity is advanced, a glance is only necessary. The chest loses the beautiful symmetry that is present in the well formed individual. The ribs are more prominent on one side; one breast is larger and lower than the other; the abdomen is less prominent on one side, and the umbilicus seems displaced from the median line.

In lateral curvature of the cervical region, there is produced a characteristic alteration in the outline of the neck. The graceful double curve becomes flattened; the neck is shorter and the shoulder less prominent on the one side; while on the other side they are more prominent.

In severe cases of lateral curvature, in addition to the inconvenience and discomfort of the deformity, there is usually disturbance in the functions of the internal organs. Shortness of breath, palpatation of the heart, impaired appetite and indigestion are present.

Nervous symptoms are present in some cases. Indisposition to exercise, vague complaints of pain and discomfort, and tenderness in the back are mentioned.

After the patient reaches the age of maturity, the deformity is permanent, and unless it is very severe he may pass through life with little or no inconvenience from it.

CHAPTER V.

LATERAL CURVATURE (CONTINUED).

Diagnosis—General, To Determine Advancement of Disease; Prognosis—Tend-
ency with or without Treatment ; Treatment—Removal of Cause, Strength-
ening of the Weakened Structures, Correction of the Deformity.

Diagnosis. The diagnosis of lateral curvature, in a se-
vere case, is so simple, that a careful inspection of the patient
is all that is required. In less marked cases, however, the
early recognition is more difficult.

A careful examination is necessary, not only for the ex-
clusion of other affections, but for the purpose of determining
the progress the deformity has already made.

The clothing should be removed from the upper part of
the patient's body, as far down as the hips. The patient is to
assume a natural attitude, and the back be inspected in a
good light. The very earliest diagnostic sign is that one
scapula is more prominent than the other.

If the patient is not too fleshy the other points in the de-
formity as described in the symptoms, can be readily noted.
If it is a fleshy subject, the tips of the spinous processes should
be accurately followed with the fingers and their location be
marked with colored chalk or a lead pencil, on the skin. The
serpentine character of the spine, with the primary and sec-
ondary curves, are made plain to the eye.

It is well to place the patient in different positions, as
that of bending forward or sidewise, and observing the sym-
metry of movement. It is best to measure the lower extrem-
ities, to determine whether or not the curvature is due to an
altered relation of the pelvis to the spine. The distance from
the anterior superior spine of the ilium to the inner malleolus,
should be the same on both sides. If so, the cause must be
located above the pelvis.

To determine the stage of the affection, or the progress the distortion has made, in addition to examining for the flexibility of the spine, the patient must be suspended, so as
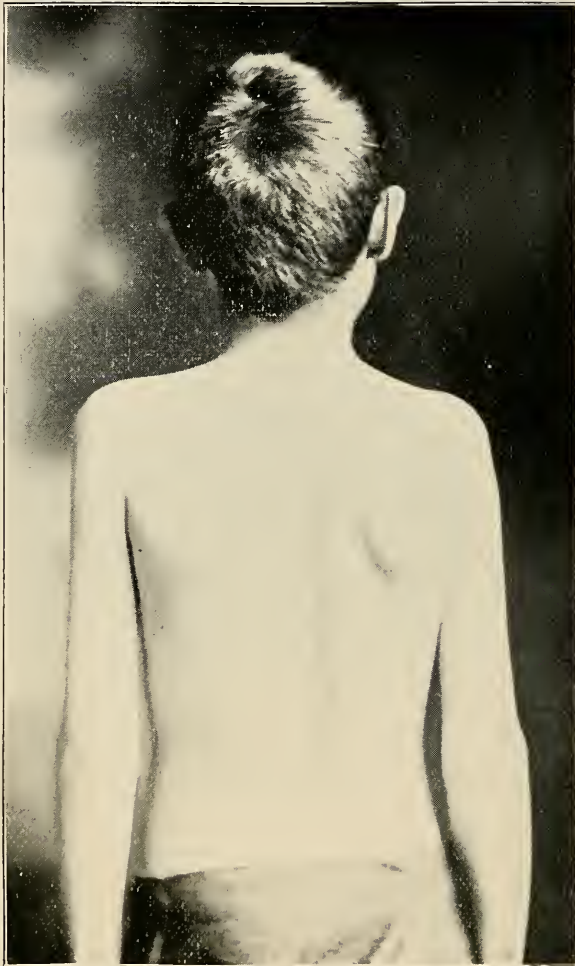
Fig. 89.   Showing the elevation of the scapula, an early symptom of lateral curvature.

to remove the upper body weight. In mild cases, and those of short duration, the curves straighten out under suspension. Those cases where the deformity is very little modified

by supension, the parts have become more firmly fixed in the distorted position, and are considered advanced cases.

In the absence of a suspension apparatus the patient may

Fig. 90.   Showing effect of suspension, with one hand raised above
the other.   Same case as Fig. 87 and 88.

be placed in different recumbent positions, and the perma-
nency of the deformity determined.

Prognosis. By far the largest number of cases of lateral
curvature only suffer a slight deformity. Coming on during
the growing period, when maturity is reached, the pro-
gress toward distortion is arrested. The deformity persists
through life, causing no trouble, and is recognized only by the
tailor, or some near relative.

In other cases, however, the deformity steadily increases
for a long time, and an enormous distortion is produced,
causing great debility and weakness. If the distortion is not
severe and it is treated early, or during the growing period, it
can be nearly if not completely cured. Benefit from treat-
ment is more to be expected in the younger, than in older
patients.

The distortion remains without improvement if left to
itself, as no cases of spontaneous cure have been recorded.

Treatment. The treatment of lateral curvature should
be directed toward the removal of the cause, the strengthen-
ing of the weakened structures, and the correction of the de-
formity.

In cases of recent development, probably the removal of
the cause will be all that will be required to produce a cure.
Correct the faulty position in all cases, and see that this is
enforced by a constant attention. It is well to carry this
to an over-correction, while the patient is under treatment.

If in young children, make them sleep on the other side and
thus curve the spine in the opposite direction; if in youth, try
and secure an over-correction of the habitual faulty position.

In cases of debility, rickets or paralysis, much attention
must be given to treatment of the general trouble, as well as to
the cure of the spinal curvature. The indications for medical
treatment must be met, as well as administering the proper
food, together with hygiene and exercise. When the cause is
due to altered pelvis, the condition must be corrected by plac-
ing extension on the sole of the shoe of the short side. Volk-
mann's oblique seat, or a modification of it, is valuable in pro-
ducing an over-corrected position while sitting.

In pathological conditions of the trunk that are liable to produce lateral curvature, some consideration on the part of the surgeon is necessary in using precautionary measures against the development of permanent deformity.

In strengthening the weakened structures, in addition to what has already been said about removing the cause, the patient must be systematically treated by means which have a tendency toward developing strength in the weakened parts.

Movement exercises, gymnastics and electricity are among the means most readily at hand.

Movement exercises, and the proper attitude must be
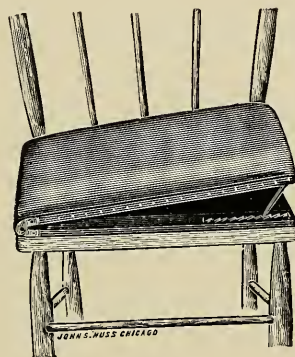
Fig. 91.   A modification of Volkman's seat used for the correction of lateral curvature.

taught the patient by a competent person.   He must be drilled into standing and walking erect; sitting in the proper position, and performing movements that will bring the weakened muscles into action, while the strong side is held at rest. The movements should be directed in such a way as will have a tendency to draw the spine into its natural position. If necessary, an assistant should help the patient, by grasping the body, or by making pressure so as to still further reduce the curvature. Movements, while lying on the face, then on the back; movements while lying with the shoulders over the end of a convenient table or couch; exercises in the upright position, perhaps best conducted by the use of the

Whitley exerciser, or some rope and pulley apparatus; swinging bars, with double bars so that one hand can be placed higher than the other. A great variety of movements can be taught that will be followed by good results. They must be persisted in, but done systematically, and never carried to fatigue. Much depends upon the instructor.

Gymnastics as are ordinarily prescribed in the gymnasium for lateral curvature, will be found to help. They consist principally in trapeze and hanging exercises, dumb bells, clubs, uprights and bars.

Fig. 93.   Showing exercise on a table for the correction
of lateral curvature.

Home gymnastics are preferable to the gymnasium, as all of the necessary outfit can be procured at small expense, and is better to be used in connection with other exercise movements, and under the direction of an instructor.

Electricity is a valuable remedial agent used to increase

the circulation in weakened parts, and tone up weakened muscles. At present the alternating current of a static machine applied over the parts seems to give the best satisfaction. It should be used regularly every second or third day, for a few moments at a time. The effect should be that of stimulation and should not be used long enough to overtax the patient.

   Correction of the Deformity. The methods above recommended for correcting the deformity by exercise will produce a cure in mild cases. There are other cases, however, where it will be found necessary to relieve the spine from the superin-

Fig. 93.   Corset brace for the correction of lateral curvature.

cumbent pressure, in order to derive the proper benefit from the treatment.

   A mechanical support is demanded in some cases, not to forcibly correct the deformity, but to act as a support where the spinal structures, ligaments and muscles are too weak to carry the load. It is best to wear it only when the upright position is assumed for a sufficient time to tire the patient.

   The most useful apparatus for this purpose is the corset. A well fitted combination corset with steel base and upright,

with cloth and whalebone between, is probably the best. The corset should be made to fit the body evenly and snugly while the patient is suspended or recumbent, with the curves of the spine reduced as far as possible. Then when the patient assumes the upright position it performs the supportive function.

The plaster of Paris jacket makes a convenient support when cut through in front and laces inserted, so that it can be applied and removed at will.

It is important to see that any appliance fits the patient properly. In growing children, frequent changes must be made and the body allowed a certain amount of freedom, or the apparatus might do harm instead of good.

CHAPTER VI.

TORTICOLLIS.

Definition—Etiology—Habitual, Spastic, Traumatic, Paralytic, Compensatory; Pathology—Symptoms—Diagnosis—Prognosis—Treatment—General, Appliances, Operative.

Torticollis is a distortion of the neck in which the head is held awry. It is commonly known as *wry-neck* and may be acute, coming on at various intervals, or chronic. It is a common deformity, and is found about as frequently in the male as in the female. It occurs usually during the growing period.

Etiology. Some authors (Bradford, Young,) consider that certain cases of torticollis are congenital, but the supposed congenital cases result mostly from injuries the infant received at the time of birth.

Acquired torticollis presents several varieties suggesting the cause of the deformity. The principal ones of these are the habitual, spastic, traumatic, paralytic and compensatory forms.

The *habitual faulty position* of the head in children may contribute to torticollis. Examples of this has been observed where the position was assumed from unequal vision. (Quignet, Young.) Too constant side position of the head while performing certain exercises (Millit, Bouvier,) as in speaking, writing, standing, etc.

The *spastic variety* include those cases which arise from either direct or reflexed nerve irritation. The lesion producing the irritation may be central—in the brain, spinal cord or along the nerve; or it may be at the periphery, as in tetany from teething, or irritation of the genital organs. Acute torticollis is often present in chorea as the spasmodic effect on the muscles of the neck.

The spasmodic contraction of the muscles in cervical Pott's disease, has already been described under that subject. Spasmodic contraction of the muscles also frequently arises from inflammation in the parts about or adjacent to them. Suppurative inflammation of the cervical lymphatic glands is a common cause.

Where torticollis accompanies an inflammatory condition, the muscles involved in the contraction are always those which lie nearest to the inflammation.

Traumatism, anywhere in the region of the neck is liable to be followed by torticollis. Lacerated and contused wounds,

Fig. 94.   Torticollis from habitual faulty position.

burns and scalds, operations, etc., especially if followed by suppuration and granulation to any extent, are liable to produce the deformity. Violent exercise often produces a straining of the muscles of the neck, and in connection with exposure to cold, acute torticollis results. Cases are mentioned (Lovett) where at time of birth the sterno-mastoid muscles were ruptured and typical torticollis followed.

Paralytic torticollis is rarely met with, but does sometimes occur following infantile paralysis. It may occur where the muscles on one side of the neck have been paralyzed for

a long time, and recovery has gradually taken place, leaving
an unequal action of the muscles.

Compensatory torticollis is met with in lateral curvature
as a secondary cure. It usually arises from weakness of the
muscles and ligaments that act in holding the spine erect, or
because the spine below is curved out of its natural position.
cases sometimes occur with lateral curvature where the curve
in the cervical region is primary, and the curves below are
secondary. (Young.)

Fig. 95. Torticollis from cervical Pott's disease.

Pathology. The pathological changes that take place are
found chiefly in the muscles, ligaments and bones of the
neck.

The muscles from causes as stated above act unequally,
those on one side being more contracted than on the other,
thus producing the twisting of the neck. The greater the
muscular variation, the greater will be the deformity. The
longer time the cause exists, the more permanent the mus-
cular contraction will become, until finally the muscles may
be permanently shortened.

In old cases the muscles on the affected side may be replaced by fibrous tissue, and where the deformity is severe, the degenerated muscles, fascia, and skin all become firmly adherent.

Cicatrical tissue often acts in connection with the muscles in producing the drawing of the head to one side.

When the torticollis has existed for a considerable length of time, changes in the ligaments and bones take place. The ligaments are shortened on the short side and lengthened on the long side. From the alteration in the line of pressure on the vertebral bodies, these gradually change in shape from

Fig. 96.   Torticollis from paralysis.   (Young.)

pressure atrophy, the pressure being greater on one side of the vertebral body than it is on the other. The intervertebral cartilages are also changed in shape similar to the change which take place in the bones.

Changes in the expression of the face are described as resulting from the pulling of the skin and fascia on one side, and the altered circulation. (Bouvier.) Asymmetry of the head and lower jaw exists in many cases. (Nelaton.)

The irregularities in the face and head are more noticeable after the torticollis has been corrected.

Symptoms. The principal symptom in torticollis is the

abnormal position of the head. Upon one side the ear is brought nearer to the sternum, the face is rotated toward the opposite side, and the whole head is tilted with the chin more or less elevated.

The position of the head varies according to the cause of the torticollis and the muscles that are involved in the shortening. Usually, however, it is the sterno-mastoid muscle that is contracted, and it is seen to be much more prominent on the affected side.

Acute or spasmodic torticollis only lasts while the exciting cause exists. The torticollis may come and go at intervals as in chorea, spasm, or acute inflammation involving the neck.

Chronic torticollis retains the head permanently if not cured and the position of the head cannot be materially changed by attempting to press it back into a natural position. In the chronic cases we sometimes have the altered expression and the asymmetry of the head as well as the face.

Diagnosis. A typical case of torticollis is easy to diagnose. In any attempt to correct the position of the head, the sterno-mastoid muscle is made very prominent; otherwise rotation of the head is free.

The history will assist in determining whether a case is acute or chronic. If acute and accompanying an inflammatory condition, as Pott's disease, cervical adenitis, irritation in the muscles, or spasm, an attempt to correct the deformity will induce pain.

In chronic cases, the parts are usually so firmly fixed by organized muscular protection that little or no pain is experienced in attempted motion.

As torticollis is frequently a symptom of other troubles, it becomes necessary to consider it in connection with them, which will be done under each appropriate subject. (See Pott's disease, Lateral Curvature, Paralysis, etc.)

Prognosis. Acute torticollis from spasm of the muscles, or any acute inflammation in the structures of the neck, usually lasts only while the exciting cause exists. It then subsides. It may become chronic and permanent. The ten-

dency, however, is toward recovery upon the removal of the cause. When structural changes have taken place in the muscles, ligaments and bones, the deformity remains through life unless relieved by treatment. Some of the more severe cases are incurable.

Treatment. The early treatment of torticollis will depend to a great extent upon the cause of the deformity. In acute cases all that will be necessary is to remove the cause and the head will assume its proper position.

In young children with habitual faulty position of the head from lying too constantly on one side, and those that habitually hold the head to one side while speaking, sitting or standing should have the corrected or over corrected position forced upon them. The correction should be watched by an attendant and movement exercises should be practiced for the purpose of strengthening weakened muscles.

Young, and others, have succeeded in curing torticollis by correcting the insufficiency of vision with the proper application of glasses.

Spastic torticollis is best treated by removing the source of the irritation of the nerves that stimulate the contraction of the muscles. Operations may be necessary on a remote part of the body, as the genital organs or the teeth. Internal medication is of great value in cases of chorea as well as in those where the lesion is in the brain or cord.

Torticollis from caries of the bone is best relieved by the use of the jury-mast as described under Pott's disease. If due to superficial inflammation, local applications and quiet in the recumbent position is necessary. If the inflammation subsides quickly the torticollis is relieved.

Traumatic torticollis is relieved by due attention to the injured parts to prevent the contraction during the process of repair. In cases where old cicatrices are present it may be necessary to make a dissection to relieve the contraction and then close the wound by plastic operation and with no degree of tension remaining on the flaps.

Paralytic torticollis is usually treated by keeping the head in the natural position by means of support of some

kind as a preventive measure, or resorting to operative
treatment to lengthen the muscles that have become too
short by the difference in the muscular traction of the two
sides of the neck. The paralysis should be treated as in
any case. Compensatory torticollis is treated in connection
with the lateral curvature of the spine as described under
the article on that subject.

The use of appliances to assist the muscles of the neck
in holding the head in the corrected position, is valuable in
many cases. After operation for torticollis some suitable ap-
paratus should be worn for some months to secure the head
in the corrected position.
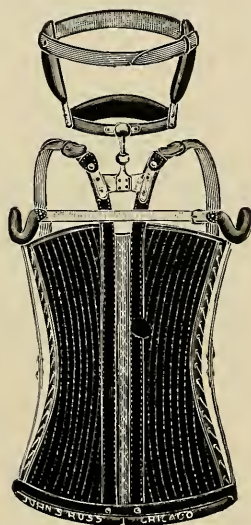
Fig. 94.   Torticollis brace attached to spinal corset brace.

The principle involved in the mechanical appliance is to
obtain fixation on the trunk or shoulders from which counter
pressure is made upon the head. A great variety of torticollis
appliances are in vogue. As a rule the more simple the ap-
paratus can be and perform its work the better.

Sayer's brace for torticollis is probably as good as any,
although it is somewhat complicated.

In mild cases an artificial muscle secured to the head by

a head band and to a band, about the chest, will assist in correcting the deformity.   (Barwell.)

Operative treatment is frequently resorted to where the muscles and fascia have become structurely shortened.   It is especially indicated when the sterno-mastoid muscle is the one that is too short.

Subcutaneous division may be employed but generally speaking it is better surgery to use the open incision. Aseptic and antiseptic precautions must be observed during the treatment.

The difficulty usually attending operative treatment is that in severe cases there is a misplacement of parts, so that unless great care is practiced, important structures may be unnecessarily wounded.   (Erichsen and others.)

Fig. 98.   Thomas' collar for the treatment of torticollis.

The danger of wounding important vessels and nerves is greater with the subcutaneous method than with the open incision.   It is often necessary to divide the contracted tissues at different places along their course so that the required relief from the deformity can be obtained.   The incision is best made along the inner border of the muscle and of sufficient length to allow the exposure of the principal contracted structures. Then with the handle of the scalpel (blunt dissection) the contracted structures can be brought into plain view and divided continuously on a grooved director.   Great care must be taken not to wound the internal jugular vein.

After all hemorrhage is controlled, the opening is to be closed by interrupted sutures. If there seems to be a deficiency in the integument, it is best to borrow a flap from adjacent parts, so that when the opening is closed there will be no great tension on the skin of the neck. Union by first intention is desirable.

CHAPTER VII.

KYPHOSIS.

Definition—Etiology—Pathology—Symptoms — Diagnosis — Prognosis— Treatment.

Kyphosis is an abnormal curvature of the spine with its convexity backward.

The deformity is usually in the upper dorsal region and is the physiological curve exaggerated. Kyphosis is commonly called round shoulders.

It may develop at any age; but develops most frequently in growing children or in persons that have passed the prime of life.

Etiology. Kyphosis is usually due to weakness, and is induced by habitual faulty position, rickets, paralysis or debility.

The habit of stooping forward while walking or sitting, especially in children that are made to sit at desks that are not the proper height for them, or sitting too long a time without exercise, contributes to the deformity. The muscles are frequently too weak and tired to support the shoulders, and the spine curves and the shoulders are thrown forward and downward, instead of the shoulder-blades being held back in their natural position.

The characteristic position of kyphosis is particularly present in children with rickets. Paralysis induces kyphosis where the muscles of both sides are affected to an equal degree.

Debility from any kind of constitutional trouble, and especially that arising from old age, acts as an etiological factor.

Certain names have been given to indicate the cause; as habitual kyphosis, paralytic kyphosis, rheumatic kyphosis, kyphosis rhachities, kyphosis professonales, kyphosis bicyclaries, etc.

Pathology. The pathological change that takes place is that of pressure-atrophy of the anterior border of the bodies of the vertebræ and their intervertebral cartilages. If present in children, as age advances it becomes more fixed and remains permanent.

In old age the bending often takes place until the margins of the bodies meet and ossification is established between the vertebræ. In rheumatic arthritis of the spine there are sometimes changes that take place similar to those in old age. The stature of the individual grows less as the kyphosis develops.

Symptoms. The symptoms are the curving of the spine in the dorsal region and drooping of the shoulders. Across the back in the upper dorsal region the shoulders are rounded from side to side. The head is held forward as if looking down to the feet.

Diagnosis. The recognition of kyphosis presents no difficulty.

Prognosis. Infants with kyphosis usually recover if left to themselves. Children will, as a rule, recover when they gain sufficient age to practice throwing the shoulders back, and walking with a straight body and a graceful movement.

When maturity is reached and kyphosis is present, it usually remains through life. In the adult, but little difficulty is experienced from the deformity. When occurring in old people, it is usually progressive.

Treatment. The kyphosis of Pott's disease is not taken into consideration in this place, as it has been fully considered in chapter V.

Common kyphosis or round shoulders, being caused principally by weakness, and faulty habits in the position of the shoulders, in order to produce a cure it becomes necessary to remove the cause as nearly as possible. The same treatment that is required to remove the cause, will benefit the deformity.

Correct the faulty position by frequently calling the patient's attention to throwing back the shoulders. Induce a proper position by providing a table or desk for writing, at school or otherwise, that is of the right height for the size of the patient. If a young person, allow a sufficient change of exercise so as

not to tire out the muscles of the back and shoulders. Teach the child to sleep on his back without a pillow, allowing the spine to lie on a level bed and without curves.

In young persons who receive the proper instruction in correcting the vicious habits which tend to produce the deformity, together with exercises and perhaps massage, a cure will be effected. The same plan of treatment will often accomplish much in the adult. Where rickets or paralysis are present, the indications must be met with medicine, treatments, etc.

An extreme case of kyphosis is best treated by the method described for the cure of Pott's disease. Braces and corsets are sometimes used to assist the weakened muscles, but great care must be exercised lest from pressure they prevent recovery instead of benefiting the condition. They should only be worn for support while in the upright position. For a mild case, the patient should depend largely upon movement exercises without the braces.

Shoulder braces with steel back and cloth straps with buckles are most commonly used, and should be applied so as to assist in holding the spine straight and drawing the shoulders upward and backward.

CHAPTER VIII.

LORDOSIS.

Definition—Etiology—Pathology—Symptoms — Diagnosis — Prognosis — Treatment.

Lordosis is an anterior exaggerated curve of the spine in the lumbar region. It, like kyphosis, usually develops during the growing period, but may come on at any time of life.

Etiology. In the great majority of cases, lordosis develops from weakness of the muscles and ligaments in the lumbar region. The source of the weakness may be congenital, but if so, the deformity itself does not appear until the child is old enough to assume the upright position and bear the upper body weight upon the lumbar spine.

Excessive superimposed body weight acts as an exciting cause, as we seldom see marked lordosis in an individual who has always been very thin and spare. On the other hand lordosis usually is present in those persons who are inclined to be very stout, in old or young persons with large fatty abdomens, or with abdomens distended from any cause, as from ascites, large abdominal tumors or pregnancy.

People of certain nationalities are predisposed to this deformity; and, as a rule, it appears in that class of people who are predisposed to rickets. It is present in nearly every well developed case of this disease.

Lordosis is usually marked in cases that are convalescing from paralysis; as in these patients the attitude is assumed in attempting to balance the weight of the upper part of the body. It is often the result of a pathological condition. In Pott's disease it is frequently developed as a compensatory curve below the inflamed portion of the spine. In hip-joint disease it is nearly always an accompanying symptom. If

the hip disease be cured spontaneously with more or less fixation, then the lordosis will remain permanent.

It is present in cases of congenital dislocation of the hip joints. In these cases the position is assumed in order to restore the axis of the spine over the line of equilibrium, which has been altered by the dislocation.

Pathology The pathological changes that take place are from the altered relations of the parts to one another. Certain groups of muscles become shortened while others become lengthened. This is equally true of the ligaments.

The bones also suffer a change of shape, especially in protracted cases, from pressure-atrophy on the concavity of the curve. They become wedge-shaped, with the base of the wedge anteriorly.

Symptoms. The principal symptom is a marked hollowing out, or curving forward in the small of the back. The abdomen appears prominent, and usually there is a compensatory curving of the dorsal spine backward. The stature of the patient appears somewhat shortened, and a peculiar movement of the lower extremities is noticed in the gait.

Diagnosis. The diagnosis is very plain. A glance at the back is all that is necessary.

Prognosis. If the deformity has existed for a considerable length of time or until maturity, it becomes permanent. It has a tendency to grow somewhat worse after the period of decline is reached.

Lordosis, after existing only a few months may entirely disappear. In cases treated, the tendency is toward improvement.

Treatment. The treatment should be directed toward removing the cause as well as reducing the deformity. The principal cause of the deformity being that of weakness, every effort must be made to strengthen the weakened structures, and while so doing the superimposed body weight should, be somewhat supported by artificial means.

Those means of treatment for strengthening the muscles that are mentioned under the subject of lateral curvature, are applicable here. (See Sec. III, Chap. V.)

In many cases supports will be of great assistance. Either some form of corset or an appliance to act as a support to the back may be used. The support should come well down on the sacrum below, and well on to the shoulders above, and be composed of elastic strips of steel covered with cloth. As a counter support to the abdomen a wide abdominal supporter or belt should be worn and secured to the upright pieces in the back. The wearing of an apparatus constructed on this principle will be found a comfort to this class of cases.

When it occurs in connection with other spinal disease it must be treated in connection with the other deformity.

SECTION IV.
JOINT DISEASES IN GENERAL.

CHAPTER I.

GENERAL CONSIDERATION OF JOINTS.

Diarthrodial Joints—Bones, Articular Cartilage, Ligaments, Synovial Membrane—Synovia—Muscles—Nerves—Circulation — Bursa — Movements of Joints.

The joints are greatly subject to injury and disease, which, as primary affections, contribute to secondary deformities. The class of articulations that are of most interest to us in this connection, are the diarthrodial joints, or those admitting of a considerable degree of motion.

Diarthrodial joints have an anatomical construction that should be kept well in mind, because of its influence upon the pathological processes which take place in the various affections. The bones entering into joint formation are expanded at their articular extremities and consist of cancellous tissue, covered by a thin compact layer of bone. and this covered with a layer of articular cartilage. They are bound together by a capsular ligament which is strengthened by other ligaments and bands as are required, and the whole are attached firmly to the bones and closely connected with the periosteum.

The joint cavity, excepting over the articular cartilage, is lined with synovial membrane, which forms a closed cavity, excepting a possible communication with a bursa. The synovial membrane is sufficiently lax to permit of normal motion in the joint, and consequently is more or less folded, and within the folds are portions of fat.

The synovial membrane is a serous membrane secreting the synovia into the joint cavity, and is well supplied with nerves and capillary blood vessels. While the serous surface secretes the synovia and is constantly covered with it, this surface also has an absorbing function. Ordinarily

the amount of synovial fluid in a joint is just sufficient for lubricating purposes ; for example, the amount of synovia contained in the knee joint, is not more than two or three cubic centimeters. (Ransohoff.) Synovia is a clear, alkaline fluid, much like the white of an egg. Its constituents are abumin, mucin, fat, leucocytes and epithelial cells.

The synovial membrane is more liable to inflammation, and to intense reaction from slight irritants, than other joint structures. It is sensitive to disturbing causes, whether it be from injury received by direct or indirect violence, or from poisons or irritants brought to it by the circulation.

To the outer side of the joints, and often connected with them, are the bursæ, which play an important role in the gliding of the tendons and the skin over the joint structures.

The normal movements at the joints are naturally dependant upon the action of the muscles that preside over them. Abnormal or exaggerated motion is prevented by the ligaments. The synovial cavity, as a rule, has the largest capacity when there is a slight flexion at the joint.

CHAPTER II.

SPRAINS.

Definition—Location—Severity—Symptoms—Pain, Swelling, Limitation of Motion, Ecchymosis, Fever; Examination—Diagnosis—Prognosis—Treatment—Rest, Application, Aspiration, Operation.

A sprain is an acute inflammation in a joint from indirect violence. It is usually produced by the movement being carried beyond its physiological limits, but not so far as to produce a dislocation.

Sprain is by far the most common of joint troubles. It is produced by a sudden wrench or twist of the articulation and may occur at any joint. The joints most subject to sprain are those of the ankle and wrist; the former because of a misstep or a fall upon the foot, and the latter from a fall upon the hand.

The degree of sprain may vary from that which is so slight that its effects quickly subside, to that where the injury and inflammation are so extensive that the whole joint becomes involved.

Only a ligament on one side of the joint may be affected or a section of the capsular ligament, with its underlying synovial membrane, may be involved. The injury may have only produced a stretching of the ligaments, or there may have been a complete rupture with hæmorrhage or extravasation, which was followed by inflammation.

In severe cases, upon one side of the joint the ligaments and synovial membrane are stretched, and perhaps torn, while on the other side they are compressed and bruised. The articular cartilage and articular surface of the bone may also be bruised. Extravasation takes place rapidly, and adds to the gravity of the case. The ligaments, as a rule, give way at or near their bone insertion. In the tearing of a ligament from

its osseous attachments, particles of bone and periosteum are not infrequently brought away with it. When occurring at the lower end of the radius, or at the lower end of the fibula they are called sprain fractures. (Callender.)

Still more grave is a sprain involving the round ligament of an enarthrodial joint. If its important blood vessels are ruptured and hemorrhages take place into the cavity of the joint, the head of the bone which gets the larger part of its nourishment through the arteries of the round ligament, and is quite apt to necrose from cut-off blood supply.

Sprain is most common in the young, and in adults whose muscles are feebly developed and the ligaments relaxed. It is often present in the same joint repeatedly, as a joint having been once affected, the ligaments are weakened, and sprain may occur again where unusual strain is placed upon it.

Symptoms. The first and most prominent symptom is pain. It follows immediately on receipt of the injury, and is at times so agonizing as to cause the patient to faint. After the receipt of the injury there may be a few hours of comparative ease and then there is a return of suffering from the tension and inflammation.

Swelling takes place rapidly when there is extensive hemorrhage into the tissues or joint cavity, or slowly when it is a part of the inflammation. It is more noticeable where the injured parts are near the surface. Swelling in the deep seated joints is evident from the position of the extremity.

Limitation of motion accompanies the inflammation, and is due partly to the swelling within the joint, and partly to irritated nerve filaments, the sensation being reflexed, producing a spasmodic contraction of the muscles.

Ecchymosis often follows sprain and may be found over the injured structures or at some distance from them. It usually makes its appearance two or three days after a severe injury.

Fever and acceleration of the pulse is present in some cases.

The symptoms as a rule, attain the maximum within the course of twenty-four hours. When the injury is severe and

considerable hemorrhage takes place into the joint, the maximum may not be reached for a week or ten days.

Acute synovitis is a characteristic of the severe cases, often tending toward chronicity as time advances without a cure. The swelling is principally due to the distention of the joint cavity with the fluid—a mixture of synovia, blood and serum. As the synovitis becomes more chronic the corpuscles leucocytes and endothelial cells accumulate, giving the fluid a turbid or purulent appearance, then sometimes called purulent synovitis. If the bone is involved, the symptoms may be characteristic of an osteitis or an osteitis and synovitis combined. The longer the inflammation remains the greater will be the tendency toward permanent deformity, which will be in the form of flexion and fixation of the joint.

Diagnosis. The diagnosis of sprain is not difficult. The history of an injury, quickly followed by an inflammation is all that is necessary. It is distinguished from fracture by the absence of crepitus, and from dislocation from the fact that no misplacement of the bones has taken place.

To be able to determine the extent of the injury and the parts involved is often very difficult. A careful examination will be of great assistance in locating the inflammation. The examination should be by extension, by the determination of the presence or absence of fluctuation, and by pressure to determine if the part affected is the ligament, synovial membrane or bone.

The following points may be elicited:

1. If the sprain only involves the ligaments, pain will be increased by extension and by making pressure over the points of attachment to the bone. No fluctuation will be present.

2. If it involves the synovial membrane, there will be general swelling of the joint, with fluctuation. Swelling takes place principally by a bulging between the bony prominences around the joint. Pain will be increased by any manipulation of the extremity.

3. If it only involves the articular cartilage and the bone, extension and counter extension relieve pain. There may be very little swelling and no fluctuation.

Prognosis. It may be said that generally the tendency in sprain is towards recovery. This, however, varies greatly according to the extent of the injury; the part of the joint which is involved; and the promptness and efficiency of the treatment.

In severe cases the progress towards recovery is often very tedious—months may pass before the normal condition is brought about. Impairment of motion often results from the adhesions. Where the joint has been once severely sprained, recurrent attacks are common.

In neglected cases, and in those persons with a diathetic disease, sprain is often the exciting cause of a chronic joint disease.

Treatment. In the treatment of sprains absolute rest should be at once secured. Elevation and suspension of the affected extremity will often relieve the pain. The elevated position will act as a sedative and allay hemorrhage and swelling.

If the case is seen immediately after the injury, a plaster of Paris bandage may be applied with great advantage. It should be applied to the skin, without padding, and made to extend to some distance above and below the joint. It will greatly lessen the congestion, hemorrhage and effusion, and prevent inflammation. It should be left on for a week or ten days and when removed, if much sensitiveness remains, it should be reapplied for another week. When the sensitiveness has subsided, passive movements and massage should be instituted.

The great majority of cases of sprain will be well advanced in inflammation and swelling, before the physician is called to treat them. Then it is best to begin the treatment with hot dressings held in place with a spica bandage in connection with elevation and suspension. For some time the dressings should be changed often and applied as hot as can be borne.

The hot dressings may be followed by a more permanent dressing. As a local application the author's favorite perscription is as follows: Carbolic acid, one dram; specific belladonna, three drams; acetate of lead, two drams;

water, eleven ounces. Saturate the dressings with this solution and apply to the joint and secure this with a bandage.

A spica bandage is to be carried over the extremity, producing even and firm pressure over the joint. Absolute rest must be insisted upon. The dressings and bandage should be changed once or twice a day, and every effort made to cause the inflammation and swelling to subside as rapidly as possible.

When the acute inflammation subsides and a large amount of effusion remains in the synovial cavity, thorough aspiration should be employed. It should be performed under the most strict aseptic precautions and a plaster of Paris bandage applied. If pain follows the operation it is well to apply an ice bag over the plaster.

In some cases where all the external signs of inflammation have subsided, there may remain a sensitiveness of the bone. In these cases it is best to immobilize the joint by the use of plaster as above described, and continue its use until the soreness has disappeared. Every time the plaster is reapplied some motion should be made to prevent ankylosis.

After the sensitiveness has subsided, massage and electricity are of great value in restoring the functions. They should be administered methodically and regularly. The passive movements should not be done roughly, nor carried too far, but they should gently, and gradually increase the mobility of the joint. The tendency toward deformity is overcome by keeping the joint in as nearly the normal extended position as possible.

Operative Treatment. The author has, on a number of occasions, operated upon sprained joints by open incision.

Operative treatment may be considered first; where there is extensive hemorrhage into the joint, and, second; when the affection does not readily yield to the more conservative methods of treatment.

Organized blood clots, fragments of cartilage or bone, granulation masses, fibrous shreds and fluid, have been found within the cavity of large joints, and upon their removal the distressing symptoms were permanently relieved. The great

danger in opening joints is from the infection of the serous cavity, causing septic inflammation to arise which not only endangers the patient's life but ultimately sacrifices the function of the joint.

If the operation is performed under absolute asepsis, and all precautions taken in the after treatment, there is no danger from it. A wound in the synovial membrane heals by primary union, as does a wound in the skin.

In opening a joint a free incision is made and the cavity thoroughly irrigated, preferably with a warm normal salt solution. In severe cases that have existed for a few weeks, where inflammation is pronounced, an iodoform emulsion should be injected into the cavity.

In closing the joint, use silkworm gut sutures one-fourth inch apart, passed through to secure the synovial membrane as well as the integument. The usual dressings are applied and the extremity enclosed in a plaster cast.

The dressings and cast are to remain a week or ten days. Upon their removal the sutures are removed and dressings and plaster reapplied. After the wound has healed, the treatment to restore the joint function should be carried out as suggested above.

CHAPTER III.

ACUTE ARTHRITIS.

Definition—Etiology—Pathology—Pyæmia,Puerperal Fever,Gonorrhœa, Scarlet
Fever, Diphtheria, Influenza, Typhoid Fever; Symptoms—Pain, Heat,
Swelling, Change of Function; Diagnosis—Prognosis—Treatment—Medica-
tion, Rest, Application, Operation.

Acute arthritis is an inflammation of one or more joints,
usually following some constitutional disturbance. It may
occur at any time of life.

The condition has received the following names by various
writers; *Acute Synovitis, Acute Suppurative Arthritis, Acute In-
fectious Joint Disease, Acute Rheumatic Arthritis, Gonorrhœal
Arthritis,* etc.

Etiology. Acute arthritis is not traumatic, but arises
from infection carried through the system by the blood, or
ptomaines deposited from constitutional contamination. It is
usually the sequela of diseases, which, when the conditions
are favorable, supply the bacteria to the blood.

The synovial membrane being highly sensitive, is easily
affected with the poison and an inflammation—acute synovitis,
results. Pyæmia, septicæmia, puerperal fever, gonorrhœa,
exanthemata, diphtheria, acute rheumatism, and even influ-
enza, all have as a complication, acute arthritis, limited
according to the severity of the infection, and the activity of
the poison.

Pathology. Arthritis from pyæmia, septicæmia and puerpe-
ral fever ordinarily involves more than one joint, and usually
the large ones. The joint effusion is generally purulent from
the beginning. The infection is a pus microbe. Usually the
streptococcus and sometimes the staphylococcus is found. The
pus when evacuated is very foul. The tendency is toward a
rapid joint destruction from the suppuration.

Gonorrhœal arthritis, when it occurs, accompanies or closely follows the primary urethral disease. It is in the form of a synovitis and is most liable to develop when the mucous membrane of the urethra has been injured, so that the general circulation becomes infected with the bacteria.

Some investigators (Misser, Kammeres, Petrone and others) have found the specific gonococcus in the exudate removed from gonorrhœal synovitis. More frequently, however, the ordinary pyogenic bacteria has been found. In a great number of cases the synovitis is serous, and it rarely becomes suppurative. Ordinarily gonorrhœal arthritis is cured rapidly, with occasionally a fibrous ankylosis remaining. The joint most often affected is the knee, although it may involve many joints.

Arthritis from variola, scarlet fever, measles, diphtheria and influenza develop during the period of convalescence, and usually only amounts to a serous synovitis in one or more joints. In some cases, however, the bones may be also involved and then the tendency is towards chronic joint disease. In all these cases the infection is very much the same. According to Shuttleworth, the joints have been found to contain a limited number of the streptococci, staphylococci, diplococci and Klebs-Loeffler bacilli in combination or otherwise.

Arthritis as a sequel of typhoid fever, usually only amounts to a serous synovitis; however, when the typhoid bacilli is found in the joints, the tendency is toward suppuration. (Martin and Robertson in Journal of Nervous and Mental Diseases, June, 1895.)

Acute rheumatism and gout is a general condition, and occurs in the form of a serous synovitis, affecting usually the smaller joints. It always involves more than one joint, often simultaneously or in succession. After the inflammation subsides, calcareous or fibrous deposits can often be felt in and about the joint. There is a strong tendency towards subacute or even chronic rheumatic arthritis.

Symptoms. The local symptoms of acute arthritis are pain, heat, swelling and change of function of one or more joints.

The pain is usually complained of in the joint. Only in exceptional cases, as in the hip, the pain is referred to remote points. The pain and sensitiveness are usually proportionate to the rapidity of distention of the synovial cavity with fluid. The tenderness is more acute over the attachments of the ligaments than over the distended synovial membrane.

Fig. 100. Acute arthritis of the hip-joint.

The increased temperature in the joint is from the active inflammation and can be readily detected on the surface.

The swelling is mostly from the distention of the cavity of the joint with fluid. Where a high degree of infection has taken place the para-articular structures and the ligaments are involved. Often within one or two days the normal outlines of the joint are entirely effaced by the swelling. The synovial membrane and the ligaments bulge around the joint at points of least resistance from the bones and ten-

dons. In the knee, on each side of the patella; in the ankle, below the malleoli and in front; in the elbow, between the olecranon and condyles; in the wrist, about the styloid process of the radius and ulna, and the joint is also thickened antero-posteriorly. In the shoulder and particularly the hip, the effusion in the joint is manifest by the position of the extremity—that of flexion and abduction.

The loss of function is evident from the inability to use the joint, and as a rule a fixed position between flexion and extension is assumed. The more virulent the disease, the greater will be the tendency towards fixation of the joints.

The constitutional symptoms depend upon the character of the infection as well as upon the number of joints involved. There is usually an elevation of temperature of one or two degrees during the active stage of the disease. It varies greatly according to the increase or decrease of the infection. If the joint effusion is serous the temperature becomes normal in a few days; if the effusion is pyogenic, the temperature is higher, and the effusion remains and fluctuates indefinitely.

In some cases the constitutional symptoms are an index of the gravity of the local conditions. Chills, high fever, coated tongue and anorexia are evidences of the absorption of toxines into the system, and usually continue until vent is given to the contents of suppurative cavities.

There are a class of cases of acute arthritis, where the early symptoms are limited, and still they have existed a sufficient time to disturb the joint function. The serous effusion is rapidly absorbed, leaving a condition described by some writers, (Barwell, Volkmann), as dry synovitis. In this, many of the symptoms of acute arthritis are absent. The articular cartilages have been affected, and the articular surfaces of the bones come in contact with each other. There is no fluctuation, but sensitiveness, fixation, and upon an attempted motion, crepitus.

Diagnosis and Prognosis. The diagnosis of acute arthritis is easy. The distressing symptoms, together with the history of some predisposing sickness is all that is necessary to make the nature of the condition evident.

In order to form a prognosis, we must distinguish between the suppurative cases, and those where the accumulations from the inflammation are simple or serous.

In acute arthritis where the effusion in the synovial cavity is simple or serous, the tendency is toward reabsorption. Usually in a few days it disappears. In those cases where the nourishment of the articular cartilage has not been interfered with, the patient makes a rapid recovery. Much, however, depends upon the constitutional predisposition of the patient. Even under favorable circumstances, some patients are very slow to recover from affections of the joints. The older writers mention scrofula, or struma, and the later ones tuberculosis, as predisposing toward chronicity; at any rate, some cases do pass into a chronic form of joint disease. In general, it may be said that the more severe the early symptoms are, the longer it will take for the patient to recover.

Suppurative cases are more grave in their character. The destruction of the synovial membrane; the exfoliation of the articular cartilages, and a tendency towards osteitis and ulceration; the formation of numerous pyogenic openings, all have a tendency to obliterate the articulation, as well as endanger the patient's life. In suppurative cases, if recovery is brought about, it is with ankylosis.

Treatment. For convenience, it is well to consider the treatment under two headings. First; those cases where the disease is due to ptomaine poisoning and the inflammatory deposits are simple or serous; second; where it is due to a mixture of infection with pyogenic bacteria, and the deposits are suppurative in character.

In the first class the symptoms are usually so closely connected with the constitutional contamination from some other disease, that in order to remove the cause of the arthritis it becomes necessary to treat the patient in a general way. In every case direct remedies should be given to meet the indications; to increase the elimination of the poison from the patient's system. Generally speaking, the indications point toward diuretics, diaphoretics and laxatives, in connection with remedies for irritation of serous membranes. This treatment

has the double effect of first; throwing off poisons, thereby removing the source of the arthritis, and second; of hastening the reabsorption of serous fluids in the joints. Sedatives, local and general, are called for. The patient should be kept in bed during the treatment.

Locally, it is well to use applications and bandages to relieve the pain and prevent swelling. Wet boracic acid dressings, applied and held in place with a snug bandage, act well. They should be changed once or twice a day, and at each redressing the bandage should be applied a little more snugly until the swelling has nearly disappeared. Medicines, such as carbolic acid, and lead acetate in solution, which have an anodyne effect upon the skin, are useful. Irritating applications are not as beneficial in acute arthritis as they are in the chronic cases.

It is best always to keep the inflamed joints in the extended position, to avoid the deformity that so often follows inflammation.

As soon as the acute symptoms have subsided, passive movements of the joints should be commenced, but never carried so far as to injure the weakened structures, or cause much pain to the patient. Exercise should not be crowded for fear of prolonging the joint irritation. During convalescence tonics are called for.

In the second class, or the suppurative cases, the course of treatment is entirely different. The indications call for antiseptics, both constitutional and local, with evacuation of the fluids from the pus cavities.

In the greatest number of cases, an acid will be indicated, and of all the remedies, the tincture of the chloride of iron seems to meet the indications best. It is powerfully antiseptic and tonic, and should be crowded to its full extent. The emunctories of the body should be kept free.

Specific echinacea or echafolta, the specific veratrum viride and specific bryonia alba are valuable remedies to prevent the toxic effect of the poisons in the system and to promote elimination.

If the case is seen early and there is doubt as to whether

the joint contains purulent or pyogenic fluid, the local application of wet boracic acid dressings, held with snug bandages, should be used.

It is usually better to try the conservative plan of treatment before resorting to an operation. If, however, no improvement is noted, and the symptoms of acute suppurative arthritis become more and more pronounced, and there is no doubt that the joint contains pus, an operation should be performed.

The character of the joint fluid can be determined by withdrawing a small portion of it with a hypodermic syringe, and subjecting the fluid to a microscopical examination. The presence of bacteria is a further indication for operation.

Operative Treatment. Opening the joint cavity, the thorough removal of the pyogenic accumulations, and the cleansing of the cavity with an antiseptic, are the principal features in connection with operations for acute suppurative arthritis.

All operations on joints should be done under antiseptic and aseptic precautions. Some operators (Barwell, Gibney, Willard), prefer to aspirate the joint and use an antiseptic solution to thoroughly cleanse the cavity.

Sayer and others, make free incisions on each side of the joint and irrigate frequently until the cavity heals. In these cases the extremity must be kept in the extended position so that if ankylosis occurs it will be in the most useful position.

Some (König, Senn and others), aspirate the cavity of the joint, and, after irrigation with a mild antiseptic, inject it with iodoform emulsion, producing immobilization for a week or two by the use of a plaster of Paris cast. This procedure will be found to be of great service in cases where the activity of the poison is limited.

In cases where the destructive changes are extensive and especially if necrosis is present, excision is necessary.

Synonyms—History—Etiology—Infection, Heredity, Injuries ; Pathology—
Osteopathic, Arthropathic; Symptoms—Lameness, Swelling, Muscular Wast-
ing, Deformity, Pain, Abscess; Diagnosis—Differential Diagnosis.

*White Swelling, Tumor Albus, Granulating Synovial Tu-
berculosis, Fungus Arthritis, Scrofulous* or *Strumous Joint
Disease, Spina Ventosa, Caries of the Joints,* are names that
have been used to denote tubercular joint disease.

Richard Wiseman described white swelling in 1734. In
1807, Samuel Cooper declared that scrofula and tumor albus
were identical. In 1842 Rokitansky demonstrated that tu-
mor albus was in many cases due to tuberculosis of the
synovial membrane. In 1865 Volkmann found tubercles in
diseased joints. In 1869, Kuster noted the frequency of miliary
tubercles in white swelling. Afterwards, the doctrine that
the disease is tubercular was further demonstrated by Fried-
lander, Hueter, König and others, so that before Koch's dis-
covery of the bacillus of tuberculosis in 1882, the tubercular
nature of white swelling, spina ventosa, fungus and strumous
arthritis had been established.

Etiology, The local tubercular disease is very seldom
the result of direct infection. It is, with rare exceptions, de-
pendent upon some antecedent tubercular focus. " The pri-
mary disease is not in the joint, but the bacilli of tuberculosis
are brought there through the medium of the blood." (Kraus)

According to Kummer, in forty per cent of cases the dis-
ease is local, and in sixty per cent tuberculosis may be de-
tected elsewhere than in the joint—in the lungs, 25 per cent,
other joints 10 per cent, bones 10 per cent, glands 10 per
cent, periosteum 3 per cent, and the pleura 2 per cent.

The respiratory tract is a common channel by which the tubercular germ enters the blood current, and an injury to a joint where the bacillus of tuberculosis is present, is sufficient to make a focus of disease. (Schuller.)

Sixty per cent of cases have been traced to slight injury of the joint. It has been found that a severe injury, like a fracture, involving the joint in a strumous subject is not followed by local tuberculosis. (Levings.)

In thirty-seven per cent of cases there is a history of hereditary tuberculosis. (Kummer.) Children of a scrofulous diathesis are liable to this affection.

Fig. 101. A deep sequestrum in osteopathic tuberculosis of the knee. (Park.)

When the vital forces of the body are lowered by disease, or where there is a solution of continuity of the mucous membranes, the spores of the bacillus entering the circulation may develop the tuberculosis.

Infantile diseases as scarlatina, rubeola, pertussis, or cholera infantum, may favor the development in children, while typhoid fever, cholera, septicæmia, and other infectious fevers may prepare the way for the disease in adults.

Pathology. Early in this affection the lesion is located in either the synovial membranes, or in the epiphyses of

the bone. In the former, it is known as the arthropathic, and the latter as the osteopathic variety.

Of 232 cases analyzed by Muller, the primary seat of the disease was in the epiphyseal end of the bone in 158, the synovial membrane in 46, and doubtful in 28, showing the predominance of the osteopathic variety. This classification is necessarily made early as all of the structures of the joint are involved as the disease advances.

In the osteopathic variety of tubercular joint disease, the lesion is first detected near the articular surface of the bone, as one or several pale nodules surrounded by a zone of hyperæmia. The bone trabeculæ are thickened and the cancellous

Fig. 102. Exfoliation of the articular cartilage in osteopathic tuberculosis of the hip.

spaces contain tubercles which have supplanted the fat cells. Gradually the nodules coalesce, digesting the intervening osseous structures, perforating the laminæ and the periosteum and extending the disease into the joint.

The medulla of the bone may be infected, causing an osteomyelitis, or an embolism may form in the medullary circulation and cause a tubercular infarction of bone. The gross disease of the joint appears as classified by König, as:

1. A granulating focus, which consists of cavities from the size of a millet seed to that of a hazelnut, and filled with grayish red living granulative tissue, or yellowish gray cheesy matter, or tuberculous pus,—a whitish-gray semi-opaque fluid.

2. Tubercular necrosis, where we have a large seques-

trum with tubercular products, found in the granulating foci
above described.

3. Tubercular infarcts in the diseased area, caused by
an embolism in a nutrient artery. These may remain in the
bone for a year or more, and are not easily detected, and may
even become embedded in non-tubercular cicatricial tissue,
and not disturb function.

These granulation foci are apt to become active from slight
causes, which is a very common occurrence in tubercular
joint disease, and makes a permanent recovery difficult. Small
sequestra may be absorbed, but the large ones may remain,
tending to keep up the local disease. Thus a dry form of tuber-
culosis may exist for a long time without involving the cavity
of the joint.
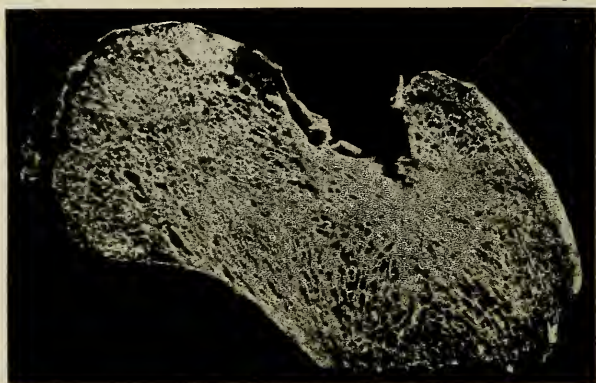
Fig. 103. Sawed section of the same bone as Fig. 102.   Tubercular destruction
of the articular lamella, and the formation of a sequestrum.

The soft or suppurating osteopathic form, may infiltrate
the tissues after it breaks through the periosteum, extending in
the line of least resistance and forming abscesses; the skin be-
ing formed into tubercular tissue at the opening. A large
abscess may come from a small bone lesion, and, *vice versa*.

The osteo-tubercular foci in the epiphyses of the long
bones are so near the joint that they usually open into it.
The articular cartilage is separated from the bone and is more

or less absorbed when the joint cavity is invaded; the general joint structures become involved in the tuberculosis.

In the arthropathic form we have:

1. The synovial membrane thickened, with a thin vascular layer spreading over the surface, and uniting with the cartilage, and eventually developing into connective tissue.

2. A subserous tumor forms, or there may be papillomatous tumors covering the whole surface of the synovial membrane. When detached these may form into movable bodies.

3. The synovial membrane appears as a thick œdematous mass, like gelatine, with islands of cheesy matter or thick pus.
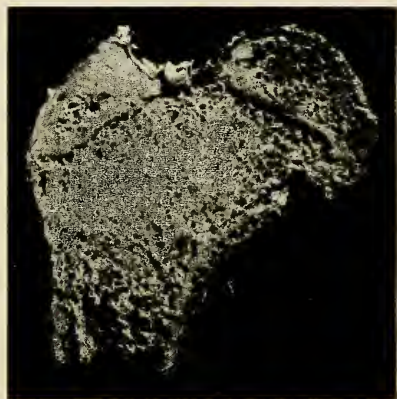
Fig. 104. Sawed section of the upper end of the femur, showing tubercular degeneration.

In any of the above forms there may be serous effusions into the joint, sometimes called hydrops tuberculosis.

4. The inside of the capsule is lined with tuberculous membrane, while the synovial membrane is infiltrated with miliary tubercles. The tubercles degenerate and form into a cold abscess in the joint.

The tuberculosis invades the circumference of the joint, within the capsule, and gradually detaches the cartilage from the bone.

Symptoms. The invasion of the bacillus of tuberculosis in limited numbers, rarely produces constitutional disturb-

ances. The early formation and development of local tuber-
cular affections, is not plainly marked by symptoms. In the
joints there are occasional pains, particularly during the hours
of the night. If the joints of the lower extremities are involved, a
passing lameness is the earliest indication of the disease. As
it progresses the symptoms become more pronounced.

The characteristic signs are lameness, swelling, muscu-
lar wasting, deformity, sometimes pain and suppuration.

Lameness. This is the earliest manifestation in the ma-
jority of cases. The patient uses the joint as little as possible
putting the burden on the unaffected joints, not on account of
the pain, but because that member seems weak and easily
tired.

In the suppurative forms, the lameness is due to the pain
caused by motion and the joint is carefully guarded against any
unnecessary movements. Sometimes remission occurs and
the lameness partially disappears. The lameness progresses
as the disease advances until the joint becomes helpless.

Swelling. This symptom is unreliable for establishing
a diagnosis of tuberculosis. In hydrops tuberculosis, it is
generally the only manifestation, and is marked, developing
in a remarkably short period. In the osteopathic form abso-
lutely no distention of the joint occurs until late in the dis-
ease, when an enlargement of the epiphyses of the bone re-
sults; soon thereafter a periarthritis develops and then the
synovial cavity is distended with the tubercular products.
The skin over the joint appears white and glossy.

Muscular Wasting. Atrophy of the muscles above and
below the joint, is an early sign and persists throughout the
entire course of the disease. The reduction in the size of the
parts is marked, as compared with the other parts of the
body.

Deformity. Swelling of the joint, together with an atrophy
of the muscles above and below, produce a deformity that is
not easily overlooked.

It exists in the majority of the cases of the arthropathic
variety and occurs at an early period. Early in the osteo-
pathic form, the deformity is nothing more than an enlarge-

ment of the epiphyseal ends of the bones. The deformity is enhanced by the power of the muscles tending to fix the joint in a flexed position.

Pain. The pain is the earliest and most persistent symptom of the osteopathic form, and is often complained of at some distance from the joint. Any sudden jar or movement causes great pain.

Early in the arthropathic variety the pains are of an intermittent nature, and relief may be had for a time, but ultimately exacerbations recur, and each succeeding attack is more painful, indicative of an active progress of the disease. The flexion of the joint is of such a nature that it relieves the pain by reducing the tension. Pain rarely occurs in hydrops tuberculosis, until the adjacent structures become involved.

Suppuration. The suppurative process of tuberculosis is insidious. In the arthropathic variety it is modified by being mixed with the synovia, leucocytes, blood cells, etc., which are the natural products of tubercular synovitis. In such cases the formation of pus may be said to be somewhat more rapid than where it occurs in the osteopathic form of the disease. The synovial cavity is distended with the fluid and sooner or later the periarticular structures are invaded and a collection of pus appears as a fluctuating substance under the skin; openings form, and in this manner numerous pus sinuses may occur.

Suppuration from the osteopathic form is slow, and presents the characteristics of the cold abscess. The formation is gradual, and the tubercular fluid may have traversed through the tissues offering the least resistance, for a considerable distance from the original seat of the disease; it finally appears as a collection of fluid under the skin, and there remains for sometime before evacuation. Tubercular abscesses are characterized by the absence of pain and heat which attend acute suppuration.

When the occasion of the abscess is due to a mixed infection, the pyogenic bacteria having entered the system at some point and having reached the seat of the disease (which offers an admirable nidus), or when the infection is direct,

through some operative procedure (aspiration of the joint, rupture of the cavity), we have a grave complication, and unless proper methods of treatment are promptly instituted disastrous results are apt to follow.

As the local tuberculosis becomes more extensive, and a large amount of tissue is involved, symptoms of general tuberculosis arise.

Diagnosis. The diagnosis of tuberculosis of the joints is plain, taking history, course and symptoms into consideration.

The disease is, for a long time local, and does not affect the general health. After the disease has advanced to the stage of suppuration, or has progressed so far that the general constitutional symptoms are present, the diagnosis is evident. The microscope can sometimes be used to confirm the diagnosis.

The severity of the symptoms always indicates the activity of the disease and the degree of destruction. Sudden pain shows a perforation of an osteal focus into the joint. A tender spot near the joint, with some softening or swelling marks its location.

In tubercular synovitis there is elastic swelling, and but little pain, and if sinuses are present, the fungoid granulations protrude.

Hydrops tuberculosis is distinguished by its persistent swelling. Small movable bodies give a friction sound. Tubercular fibroma can be felt after aspiration. Syphilis will yield to medical treatment. Simple traumatic osteitis presents none of the wasting signs of the tubercular form, and rest will cause improvement. Chronic rheumatism is polyarticular, and changeable; limy deposits can be felt about the joints. The early differentiation of osteosarcoma is difficult, but as it advances the distinguishing feature is the pain which is marked and most severe at night.

CHAPTER V.

TUBERCULOSIS OF JOINTS (CONTINUED).

Prognosis—Duration, Results, Classification; Treatment—Diet, Hygiene, Climate, Rest, Therapeutic Remedies, Joint Aspiration, Iodoform Emulsion, Injection, Resection, Amputation.

Prognosis, Tubercular joint disease extends over a period of many years; caries sicca may recover in three years; while hydrops tuberculosis and the milder forms may disappear in a shorter time. (König.)

All forms tend toward spontaneous recovery with ankylosis. Soft acute tuberculosis, or a large osteo-tubercular focus, early suppuration and neglect of treatment, are conditions unfavorable. In most cases the disease is mild, and relapses are common. Children recover more readily than adults.

Baumgarten describes three forms of miliary tubercle, by which he explains the mildness of joint disease and its slow progress, as compared with tuberculosis of the lungs:

1. The lymphoid-celled tubercle, very malignant and rich in bacilli, found in acute miliary tuberculosis of the lungs.

2. Mixed lymphoid and epithelial cells, less malignant with fewer bacilli, and found in general chronic miliary tuberculosis.

3. Epitheloid and giant-celled tubercules, with few bacilli and found in benign forms of tubercular joint disease, bones, lupus and lymphatic glands. Their mildness is proven by experiments with cultures, and experiments on animals.

The great danger to life is from mixed infection. An operation may be followed by acute tuberculosis, or tubercular meningitis, occurring in from seven to ten days. There is a tendency in course of time to amyloid degeneration of the kidneys, spleen and liver.

If the tubercular disease is extensive in the joint and adjacent bones, amputation offers the best prospect of cure; though complete removal of the diseased tissue by some other operation may result favorably.

Treatment. The principle involved in the treatment is that of raising the standard of the general health by liberal and nutritious diet, appropriate hygienic measures, change of climate, rest of the parts, employment of remedies, and operative interference.

Diet. Good wholesome food should be supplied in liberal quantities. During the winter months plenty of fats, butter and cream should be consumed.

The alimentary tract should be kept in the best possible condition, and, if the appetite is poor, the bitter tonics may be used to advantage, while regularity of the bowels should be maintained.

The *hygienic* measures can be improved upon in almost every case—sunshine, fresh air, properly heated and ventilated living quarters, clean and warm clothing; while good hygienic surroundings are essential if any surgical interference becomes necessary.

Change of climate is frequently productive of marked improvement in the disease. The ideal climate is one free from the sudden changes so common to some localities, affording pure air, sunshine, pleasant scenery, etc. The higher altitudes are in great favor.

Rest of a joint is a fundamental principle of treatment in all joint affections. By rest it is understood that the joint is protected from motion and pressure from the weight of the body, until the active symptoms of the disease have subsided. This may be accomplished in various ways—confining the patient in bed with the extremity comfortably extended; the application of splints or a plaster of Paris cast; or a well adjusted extension brace, serves, according to the circumstances of the patient, in securing the desired rest. Probably the most available method of securing rest as well as protection to the joint, is the use of the plaster cast.

In many cases an apparatus which will produce an ex-

tension of the joint is found to be serviceable, particularly in overcoming the tendency toward the contraction of the flexor muscles. In the acute stages, such extension can be best maintained with the patient in the recumbent posture. Later some form of traction splint can be successfully used. This treatment should be conducted in such a manner as to fix the joint, as well as to furnish the desired extension in preventing the angular deformity that so often results from chonic tubercular disease.

Employment of remedies. At the present time we know of no specific for the cure of tuberculosis. Our therapeutics are valuable in these cases so far as indicated to ameliorate the symptoms of the disease, and to supply the system with elements to assist in the protection of the living tissues. Iron, the hypophosphites of lime and soda, quinia, echinacea, guaiacol, or creosote, are of assistance in selective cases.

Operative Interference. Surgery yields as good results in tubercular joint diseases, as it does in other joint affections. Great care in connection with any of the operations is necessary, as a safeguard against infection. In operations where the cavity of the joint is to be merely punctured, the same aseptic and antiseptic precautions are to be taken, as in the more formidable resection.

Preparation for Operation. The technique of aseptic surgical preparation should be carried out to the letter, before any operative procedure upon a joint.

The parts are carefully shaven the day preceding the operation, and scrubbed with soap and water, a stiff brush being used. Gauze wrung out of bichloride of mercury solution 1 to 2000, is applied to the joint and allowed to remain until the time for the operation, when it is removed and the integument is again scoured with soap and water. Some antiseptic, as bichloride of mercury 1 to 1000 or a five per cent solution of carbolic acid in water, is applied in liberal quantities to disinfect the cutaneous surface. The fats are removed by sulphuric ether, and the entire surface is dehydrated with alcohol. Sterilized towels are now wrapped around the joint to protect the field of operation, and anything that comes in contact with it must have been previously sterlized.

The operator and assistants carefully disinfect their hands, and arms, and put on sterlized gowns, the instruments having been previously rendered sterile, either by immersion into ninety-five per cent. carbolic acid and subsequently washed in ninety-five per cent. alcohol, or by some process with heat. With these precautions the operation can proceed with reasonable safety.

Operations upon the tubercular joints, should be conducted upon one of two general plans. First; by joint puncture with the removal of the tubercular fluids and the injection of antiseptics. Second; open incision with the removal of the diseased foci.

I. Simple aspiration is perhaps the operation most frequently performed, and consists of merely withdrawing from the joint cavity any effusion that may exist. In performing aspiration the greatest danger is from infection or from the introduction of air into the joint cavity. Any form of an aspirating trocar or syringe can be used. This is, as a rule all that is required to relieve a case of hydrops tuberculosis, unless it has existed for a long time.

The injection of an emulsion of iodoform for tubercular joint disease, is at the present time an established treatment.

The preparation of iodoform emulsion is an important feature. The glycerine emulsion seems to be in greater favor and is prepared as follows: Rub 90 grains each of powdered iodoform and powdered acacia (pure) together in a porcelain lined dish, add three drams of distilled water and rub until smooth, add glycerine C. P. two ounces; heat on water bath, continuously stirring with a glass rod, with the temperature at the boiling point of water, for thirty minutes. Pour into a sterile bottle and cork until ready for use.

De Vos recommends the use of an oil emulsion that is prepared according to the following manner: 10 grammes of iodoform powder placed in a black bottle, and covered with bichloride of mercury solution, 1 to 1000, for four days. The powder is then thoroughly washed with sterile water. To the iodoform mixed with repeated shaking, add 100 grammes of sweet oil, which has been boiled for ten minutes and cooled to $30°$ C.

The quantity of iodoform that may be safely injected into the tissues, varies somewhat in different cases. Generally speaking it is considered safe to inject from ten to twenty grains at each treatment.

After the parts have been prepared as before stated, an aspirating needle is inserted into the joint between the bones, and the fluid (if any be present), is withdrawn, after which the iodoform emulsion is deposited within the cavity. If the case be primarily osteopathic, an effort should be made to introduce the emulsion as near the seat of the disease as possible (within the cancellous bone tissue). Tuberculous bone is comparatively soft and will easily admit the needle of the syringe. After the needle is withdrawn, the opening in the skin is sealed with iodoform and collodion.

The joint is then fixed and protected by the application of a plaster of Paris bandage, applied over the joint, and to some distance above and below. It is well to keep the patient in bed following this treatment. This injection may be repeated as soon as the tenderness occasioned by the previous treatment has subsided, which is usually in from seven to ten days. After three to five similar treatments evidences of the desirable improvement will appear if it is to occur.

Many cases of tubercular joint disease are cured by the removal of the fluid; cleansing the cavity with a mild antiseptic and filling it with iodoform emulsion. Where the abscess is not contaminated with infective material from without, even though sinuses are present with external openings, it is possible to cleanse the parts with antiseptics, fill the joint with the emulsion and secure healing by first intention. (Waterman, Trans. American Orthopedic Assn., 1896, advocates the injection of hydrochloric acid through the sinues.)

II. The greater number of cases where discharging sinuses exist, are best treated by open incision—scraping or cutting away every particle of tuberculous and degenerative tissue, and filling the cavity with an antiseptic. After which treat as an open wound. If the operator feels reasonably assured that the entire diseased tissue has been removed, the wound may be closed with deep and superficial sutures, and covered with dressings, and immoblized with a plaster cast.

Many surgeons prefer to pack the wound with iodoform gauze for two or three days, after which it is closed by sutures introduced at the time of the operation. The ordinary surgical precautions are to be observed with regard to asepsis, and protection from motion is imperative.

Resection for tubercular arthritis offers a more effectual method of relieving the disease, especially where the distruction of bone is extensive. The advantage to be gained by resection is to effectually terminate the lesion before the infection becomes deposited in other tissues of the body.

The deformity following resection will be no greater than that which follows any other plan of treatment for advanced tubercular joint disease. This is especially true in younger subjects. Adults do not so readily regain normal usefulness of an extremity following resection.

Amputation may be resorted to in cases where a great portion of the bones and soft tissues of an extremity are involved, or where resection has failed to remove the diseased mass.

CHAPTER VI.

CHRONIC RHEUMATIC ARTHRITIS.

Definition—Etiology—Pathology—Diagnosis—Prognosis—Treatment.

Chronic Rheumatic Arthritis is a disease of the joints, of later adult life, characterized by great deformity following changes in the articular structures.

It is also known by the following names: *Rheumatoid Arthritis, Chronic Articular Rheumatism, Arthritis Deformans, Nodular Rheumatism, Rheumatic Gout, Dry* or *Proliferating Arthritis, Nodosity of the Joints, Malum Senile*, etc.

The disease affects the knee, shoulder, hip, wrist, elbow, and the joints of the feet or hands, either separately or together.

Etiology. There is a diversity of opinion as to the origin of this affection; some writers claim that the disease begins as an inflammation of the synovial membrane, while others contend that the primary seat of the affection is in the cartilage. Late writers seem to agree that the onset of the disease is similar to any acute or sub-acute inflammation, and involves all of the structures entering into the formation of the joint.

The results of exposure and violent exercise favor the theory that at those times the body is most susceptible to the influences of various forms of micro-organisms and their toxines, and those periods afford an opportune time for the invasion of the poison, and the beginning of the subsequent pathological changes in the joint structures.

Some appear to be predisposed to the disease. Persons of certain temperaments are more subject to the disease than others. Whether this is due to a tendency in the system,

produced by previous disease or whether it is from some nerv-
ous derangement, still remains to be proven.

Pathology. The morbid changes begin with a thicken-
ing of the synovial membrane, accompanied with a hyper-
trophy of its fringes and a thickening of the articular carti-
leges about their margins. As the disease advances the
hyaline substance becomes fibrillated, and where there is
pressure it is worn away in small patches, or larger surfaces,
exposing the bony lamellæ, which also show evidence of
wear from the joint friction.

The cartilage about its free margin, where there is free-
dom from pressure, undergoes degeneration. The proliferating
corpusle cells which remain, take on a formative activity and
make up the marginal hypertrophy or ecchondrosis.

These cartilaginous margins may break off and form mov-
able bodies within the joint cavity. At other times they grow
laterally and can be felt as deposits about the articulation.
From the fact that these deposits ultimately ossify, an ex-
planation is afforded for the extreme changes in the shape of
the ends of the bones. The formation of the osteophytes
limit to a considerable degree the arc of motion of the joint.

The bones of these patients are somewhat brittle. The
first change after the cartilage is worn away is that of an
ivory like appearance from the friction at that point. The ir-
ritation results in hyperæmia, which is attended by a slight
degree of rarefying osteitis. If the disease progresses until
the cancellous bone tissue becomes involved, a more active
osteitis, with a tendency to ankylosis results.

The calcareous degeneration of the synovial membrane, and
of the ligaments, increases the tendency toward ankylosis, and
is followed by an atrophy of the muscles controlling the joint.

Symptoms. In the earliest stage of the disease the symp-
toms resemble those of acute arthritis. When well advanced
the symptoms are those of sub-acute or chronic articular in-
flammation; viz., limitation of motion, pain, enlargement of
the joints, and deformity.

The pain varies greatly according as the patient exer-
cises, and according to the general standard of the health.

The swelling of the joint is due principally to the osteophytes and the calcareous deposits in the soft structures.

The deformity is that of a distended joint with a flexed position of the limb.

Calcareous deposits are often found in other serous membranes, viz., in the endocardium, arteries, etc.

Diagnosis. The symptoms and history of these cases, are not easily confounded with those of any other disease. This disease is generally polyarticular and accompanied by a peculiar crepitus, which is elicited by motion.

Prognosis. The prognosis is not favorable, especially so far as complete recovery is concerned. The joints do not regain their normal usefulness after degeneration has occurred. Mild cases are benefitted by treatment, but the advanced cases are protracted, the recurrant attacks covering a period of many years, until life is ended by a calcareous degeneration of some vital organ, or by the interposition of some other disease.

Treatment. The pain and inflammation may be controlled by rest in bed, and by the application of anodynes to the joint. Counter irritation and electricity have been found to be serviceable to increase the circulation and assist in repair. Passive movements and massage are beneficial in some cases. Fats and meats should be excluded from the diet.

The progress may often be arrested by a visit to some of the mineral springs and a liberal use of the water, both internally and externally. Medication is of assistance in establishing elimination and reconstructive metamorphosis.

Operative treatment for the relief of the deformities induced is contra-indicated.

CHAPTER VII.

CHARCOT'S DISEASE.

Definition—Etiology—Pathology—Symptoms — Diagnosis —Prognosis — Treatment.

Charcot's Disease is a peculiar chronic affection of the joints, resulting in deformity, usually associated with some cerebral or spinal nervous lesion. It is also known as *Arthropathy*, *Tabetic Arthropathy*, *Neural Arthropathy*, *Neuropathic Joint Disease*, etc.

Although Mitchell called attention to joint complications of nervous diseases long ago, this disease was first described by Charcot in 1868, when it was given a prominent position in joint pathology. The disease generally occurs after adult life is reached.

According to Weitzacher and Barry, the knee is most often affected; the hips, shoulder, ankle, elbow and hand are next in frequency. It is in most cases monoarticular; however, several joints may be involved.

Etiology. The disease is most often due to some nervous lesion, either central, or of the periphery; at other times to acute myelitis, tumors of the gray substance of the cord, and to cerebral apoplexy. The most common cause of Charcot's disease is that dependent upon the degeneration of the posterior columns of the cord, or tabes dorsalis, as referred to by Charcot.

It is difficult to determine the connection between the joint affection and the nervous lesion. In most cases the joint disturbance is not noticed until after some injury. The nervous symptoms appear primarily, in some cases and in others the articular symptoms are first apparent. When

occurring secondary to hemiplegia, the nervous symptoms appear from one to three months preceding the joint disease.

Budinger states that neuropathic joint affections may be considered as the result of a central nervous lesion. He also states that traumatic forms may occur. These trophic disturbances are principally met with in tabetic patients, in whom sensory symptoms predominate. (Glorieux, Van Gehuchten.)

Pathology. Parker Syms considers the question of Charcot's disease, and emphasises the fact that the condition is one of trophic degeneration without inflammation. Suppuration is never directly associated unless incident to direct injury.

The synovial membrane is the seat of chronic asthenic hyperæmia with hypersecretion of synovial fluid. The cartilages become eroded in some places, and thickened in others; the bones in close proximity become hypertrophied, nodular osteophytes are abundant in the attachment of the capsule.

As the disease progresses interstitial changes take place— atrophy of the epiphyses, fungous formations, osteophytes and bony stalactites.

Symptoms. The local symptoms differ greatly according to the character of the nervous lesion and to the progress that the disease has made.

In the most acute form, there is redness, swelling and sometimes violent pain. Later the symptoms are those of a slow diffused indurated swelling about the tissues of the joint without the pecularities of œdema.

There may be an entire absence of pain in some cases, while in others the pain may be paroxysmal or constant, with great tenderness on pressure. The character of the pain is suggestive of tabes dorsalis. The muscles become wasted and respond only to galvanic currents of high power.

It is interesting to note some of the remote symptoms in connection with these cases. In addition to the general symptoms of locomotor ataxy, there are sometimes present, many forms of tissue malformation and degeneration. Headache, backache, vertigo, abdominal pains, etc., are frequently

noted. Various forms of tumors may be found in remote parts
of the body. Westphal describes a case where there was
atrophy of the jaw with rapid falling out of the teeth, a tabetic
foot on the right side and a perforating ulcer on the left. Ne-
crosis of the jaws is not a rare symptom in tabes and is gen-
erally associated with disturbances of the joints. (Kalicher,
Castel, Moebus.) Ulcerations of the soles of the feet and
legs are described in cases cited by Waldo, Fournier and
Girandeau.

Fig. 105. Charcot's disease of the ankle-joint. (Young.)

Diagnosis. The diagnosis of Charcot's disease is easily
made, especially when the disease is advanced. Aside from
the symptoms of the nervous lesion the rapid course of the
joint affections tending toward destruction, associated with
muscular atrophy and nervous disturbance, are sufficiently
diagnostic.

Prognosis. The affection being a secondary one, is de-
pendent upon the primary nervous disease. Usually it is
steadily progressive, and in the majority of cases, to a fatal

issue. Its course is varied. In some cases there is an occasional exacerbation, and years may elapse before it terminates.

Spontaneous recovery may be abrupt, or the disease may progress to an entire destruction of the articulation. If the original nervous lesion can be controlled, recovery of the joint disease will follow.

Treatment. The treatment is palliative. Rest of the joint by the use of a proper appliance, or fixation apparatus, may be of service in retaining the extremity in a natural position.

Locally the employment of massage and pressure bandages, may afford comfort to the patient. Galvanism has been strongly recommended by Weir Mitchell.

When the effusion is extreme, temporary benefit may be obtained by aspiration. Excision of the knee has been performed in four cases by Rotter, with fair results in two. The diminished reparative power of the tissues seems hardly to warrant so serious an operation.

Morton recently amputated at the thigh for Charot's disease of the knee and three days later the patient died. Other surgeons have met with similar results from operations in these cases.

CHAPTER VIII.

MOVABLE BODIES IN THE JOINTS.

Description—Source—Symptoms—Diagnosis—Prognosis—Treatment—Paliative, Operative.

Movable bodies within articular cavities, vary in number, size, shape, consistency and in source. They are found much more frequently in the knee joint than in all others. They sometimes are found in the elbow, and rarely in the hip, jaw, ankle and wrist joints. There may be only one such body in the joint, or there may be three or four, or many. In size they vary from that of a mustard seed, to that of the whole of an articular cartilage. In shape they may be globular, ovoid, pyriform, circular plates, concavo-convex, conglomerate, etc.

In consistency they may be cartilaginous, bony, fibrinous, lipomatous or mixed.

Source. They are most often formed from hypertrophied fringes (Barwell, Volkmann), projecting from convolutions in the synovial membrane which at first are sacculi (Rainey in Pathological Transactions, Vol. II, P. 110), and as hypertrophy goes on, fat-cells, cartilage-cells or bone-cells are deposited. The sacculi become nodules, often pedunculated for a time, and may finally break off, and become free. By this means are formed a variety of movable bodies, which, single or multiple, present the different characteristics according to the nature of the deposit and the stage of advancement.

We have seen how, in fully developed rheumatic arthritis, the osteophytes are formed, and from the above process, how they may become as movable bodies in the joint.

There are a class of cases where the movable body has been present, following some accident, such as sprain or dislocation. Such accidents can, where the hypertrophied frin-

ges are present, dislodge them, or sever the pedicle so as to have the injury followed by symptoms of a movable body in the joint.

Articular cartilage has been known to be torn from its attachments and remain as a loose body in a joint. (Howard Marsh, British Medical Journal, Apr., 1888.)

The writer has found in several post mortems, movable bodies in the knee joint, which upon histological investigation proved to be cartilage. The point of separation of the articular cartilage could be seen. In one case the space where cartilage had been removed from the articular surface was well filled with fibrous material; and the correspondingly shaped cartilage was loose in the synovial cavity of the knee joint.

Movable bodies are most apt to manifest themselves in joints that have been affected with an acute inflammation, such as that of a sprain or of an arthritis. In such cases the free borders of the synovial membrane often, from inflammation and granulation, become fringe-like, the fringe remaining and degenerating as above stated.

The symptoms may not arise until long after the original joint affection. In other cases there is no history of any previous joint trouble.

Symptoms. The first symptoms occur at a time when the joint is exercised in such a way as to dislodge the body and give it a different location.

A sudden sickening pain and a sense that something is out of place in the joint, is experienced by the patient. The joint is suddenly rendered useless, and in some cases the patient is able by some motion to change the location of the movable body and is immediately relieved. In other cases the joint remains fixed in a position of more or less flexion, and is apt to be followed by an inflammation lasting for several days.

If in the knee joint, the patient while walking is so suddenly seized with agonizing pain in the knee that he may fall to the ground or faint away. At times the pain quickly passes away without further trouble. At other times the pain is excited by the least attempt at motion.

These attacks are likely to be repeated without any as-
signable cause. Sometimes at frequent intervals, and at other
times months may pass without any trouble. With the
repetition of attacks, the joint becomes more tolerant and
the sensitiveness and danger of inflammation less pronounced.

On manipulation of the joint with the fingers, it is often
possible to detect a loose and movable body, which shifts its
position, and may be felt first in one part of the joint and then
in another. In some cases, the patient himself becomes
adept at changing the position of the body, so that he is relieved.

To the touch, the bodies feel smooth and slippery so that
they evade the grasp of the fingers. When near the surface
they may be felt near the attachment of the synovial mem-
brane, and in the spaces between the bones. Sometimes it
is impossible to feel them.

Diagnosis. The history of the case, in connection with
the finding a movable body which can be slipped from place
to place by manipulation—establishes the diagnosis. When
the movable body cannot be found, one must depend upon
the history.

It is always difficult to make out the consistency of the
body. It is possible, however, to distinguish between a bony
and a lipomatous body.

Treatment. The treatment may be either palliative or
operative. In cases where the cause is such as to produce a
great number of movable bodies in the joints, the palliative
treatment should be adopted. Where only one or two bodies
are located, or where the condition is so troublesome as to be
a serious impediment in walking, the operative treatment is
admissible.

Palliative treatment consists in using some protection to
the joint, to support it in such a way as to prevent the bodies
from changing place as far as possible. A rubber elastic cap
worn over the joint, making even pressure all around it, will
often suffice.

If the body can be located near the surface, it may be se-
cured in that situation by bandaging the joint with adhesive
plaster, leaving an opening in the bandage in the situation of
the protruding body.

In some cases a plaster of Paris cast can be applied to the joint leaving an opening as described above. It can be worn for sometime, until all inflammation has subsided. This treatment is sometimes of great advantage from its tendency to cause adhesions which may fix the body in a convenient situation.
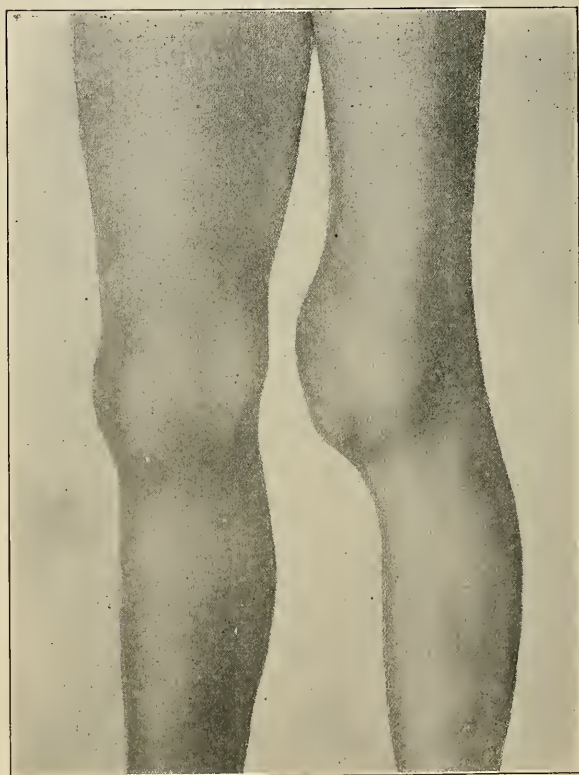

Fig. 106. Showing knee-joint two weeks after the operation for a movable body. Scar on side.

In all cases where the movable body excites any degree of inflammation it is best to secure the joint in a comfortable position and keep it at rest for a few days or until the inflammation has subsided. In the knee joint an extended position is preferable.

Operative treatment is for the extripation of the movable

body. If it has been located near the surface, the operation is often followed by but little joint inflammation.

Barwell describes the operation as follows: " Manipulating and keeping the body in some part of the joint readily accessible from without, and then shifting the skin over it as far as it will go, the surgeon with a very sharp knife cuts straight into the joint, not on the cartilage, lest the pressure of the scalpel should cause it to slip away; but a little to one side to which he has learned that it most readily passes. The opening in the synovial membrane should be quite free enough to let the body pass easily, and a little pressure towards the

Fig. 107.   Movable body removed from case Fig. 106, showing it natural size.

opening should cause it to jump quickly or move slowly, or to glide out of the wound. In either case the tract should be closed by the pressure of an assistant's hands immediately behind the body." (International Encyclopedia of Surgery.)

The body may be grasped with forceps and removed. If a pedicle be present it may be severed or twisted off. If deemed necessary the joint cavity may be explored for other bodies. It should be borne in mind that the more irritation to the joint structures there is, produced by the operation, the greater the danger of subsequent inflammation.

The wound should be sutured and the extremity placed in a plaster of Paris dressing. The extremity should be kept elevated and at complete rest until all danger from inflam-

mation has passed. If the pain from the synovitis is not too great, the dressings may remain a week before removal, and then flexion and extension should be made and a cast applied for another week.

If the operation has been performed under strict antiseptic precautions, the outcome should be very favorable. However, if infection should take place, it will be necessary to establish drainage and to resort to frequent redressings and applications of ice to allay the inflammatory process.

In cases of loose bodies from chronic rheumatic arthritis the operation is contraindicated.

ANKYLOSIS.

Definition—Etiology—Pathology — Symptoms—Diagnosis — Prognosis — Treatment—Fibrous—Bony.

Ankylosis is a condition of a joint in which the motion is impeded or abolished. The loss of mobility may vary from a small diminution in the arc of motion, to a complete obliteration of all movement. The term ankylosis is applied to the fixation of a joint in any position, not necessarily in an angular one as the etymology would seem to imply.

Ankylosis is conveniently divided in two classes, the first is called *fibrous* or *incomplete ankylosis*, the second *bony* or *complete ankylosis*.

Etiology. Fibrous or incomplete ankylosis is due to deposits or adhesions within the joint, as the result of inflammation, or in some cases to causes outside the joint.

Deposits of bone in close relation to the articular surface might by their presence limit the joint movement, and would appropriately be termed false ankylosis. In other cases the muscles that preside over the joint may be so restricted in their action from traumatic or infective inflammation that the joint movements are limited by the contractured tissues.

In studying the etiology, we find that by far the greatest number of cases are due to an inflammation that has existed within the joint. The inflammation may have been characteristic of acute, sub-acute or chronic arthritis.

Pathology. The pathological processes attending severe joint diseases, destroy the articular surface and replace it with fibrous adhesions.

The granulations and connective tissue deposits may become organized into an ossified substance, and finally a true or bony ankylosis is the result.

Usually where the ankylosis is secondary to joint disease, the fibrous and bony ankylosis is found associated with each other. For a long time the adhesions remain fibrous and finally become ossified. Later there is a complete obliteration of the joint. Suppuration of a joint cavity is always followed by a nearly complete or a bony ankylosis. In these cases the ankylosis exists at the time of the joint disease and remains after the disease has subsided.

In studying the structure of an ankylosed joint, we find that the deposits are about or between the interspaces of the articular surfaces of the bone and synovial membrane. In cases where there has been great destruction of the joint and the articular surface of the bones have come in contact with each other, the ossification is by fusion, and is direct.

In rheumatic cases the ankylosis is due to limy deposits within the joint structure, which have a tendency to form into osteophytes, and finally these may be sufficient to unite the ends of the bones.

Ankylosis sometimes exists as one of the phenomena of old age, occurring merely as a result of senile changes, and not from disease.

Symptoms. The symptoms of ankylosis are principally the limitation of motion within the joint. The joint is usually ankylosed in a more or less flexed position. In some cases where the exciting disease has lasted for a long time, the position is one of sub-luxation combined with flexion.

Considerable atrophy of the muscles above and below, give the joint an enlarged appearance.

In false or fibrous ankylosis, there is always a degree of mobility. The motion depending upon the deposits, and the amount of sensitiveness. The greatest drawback to the utility of an ankylosed extremity is the fixed deformity, and the awkwardness in its use.

Diagnosis. The diagnosis of ankylosis is simple, but it is oftentimes difficult to distinguish between the two varieties.

It is certain that if the joint admits of any motion, the

condition is one of false ankylosis. In cases where the motion is so slight that it is hardly preceptible, great care must be exercised in order to positively determine the variety. For instance; upon attempting to make motion at an ankylosed hip joint the movement is permitted by the lumbar spine, and it becomes necessary to make repeated tests for fear of mistake.

Malgaigne's test is one that sometimes proves useful. The test is made in the knee joint, for example, by grasping the thigh with one hand, and the leg with the other, and then endeavoring to flex and extend the leg, persisting in these efforts until pain is elicited. If the patient refers the pains to the joint, the ankylosis is false, but if it is referred to the limb where the tissues are grasped by the surgeons hand, the ankylosis is true. Another sign of undoubted value is the muscular action. If, during the attempts to move the joint, the muscles seem to contract and become prominent, the ankylosis is fibrous. In bony ankylosis no muscular action attends attempts at motion.

After subjecting the patient to the above tests, he should be directed to return for another examination on the second day following, and if it is found that the previous examination has excited an inflammation in the joint, it is positive evidence that motion was produced, although it might not have been preceptible at that time.

Under profound anæsthesia a positive diagnosis can probably be made, as the complete relaxation of the patient permits motion, provided the ankylosis is fibrous.

Prognosis. False or fibrous ankylosis that has been of short duration, may improve and possibly disappear by the efforts of the patient. Usually, however, there is no improvement in the range of joint motion without active treatment.

If the original source of the ankylosis has entirely disappeared, fibrous or false ankylosis yields well under treatment. Surgeons are to be cautioned, however, against operative treatment for ankylosis, where it is due to chronic rheumatic arthritis, as the results are most liable to be unsatisfactory.

The prognosis in bony ankylosis is favorable in certain cases only under operation. Like the fibrous ankylosis, all the original disease must have subsided, and the bony union be firm, then, by operation, an improvement may be brought about. Usually the choice of treatment or non-treatment lays only in the possible improvement of the position and the usefulness of the extremity.

In certain favorable cases it may be possible to get a movable joint by excision.

Treatment of Fibrous Ankylosis. Certain prophylactic measures should be mentioned in connection with treating chronic joint disease.

First; At stated intervals during convalescence, it is well to produce motion at the joint, to prevent too firm organization of the deposits. However, in those cases where the disease is outside of the joint, no special attention need be given to motion as there is little danger of internal ankylosis, unless there is inflammation in the joint cavity for sometime.

Second; During the period of the treatment of joint disease the extremity should always be kept as nearly as possible, in the position that will leave it in the most useful position, provided ankylosis should take place.

Fibrous ankylosis when limited and only existing for a short time, is best relieved by frequent and gentle passive movements with massage and douching. This treatment, if persisted in, will often be satisfactory.

In some severe and resisting cases, nothing short of forcible manipulation under an aænsthetic, will reduce the deformity. If contractured muscles exist they must be divided either subcutaneously or openly. If skin and fascia be too short, the division is best by the open method. An effort should be made to produce complete flexion and extension at the time of the operation.

The *brisement forcé* is first applied toward flexion and carried as far as possible, and then extension is made. In many cases the adhesions will yield at once with a sharp crack, or series of cracks, sounding very much as if the bone had been fractured.

Should fracture unfortunately occur above or below the joint, the operation must be abandoned until a union has taken place. Rupture of the principal arteries has been know to occur at such operations, thus necessitating an amputation.

Great care must be taken after forcible operations for ankylosis, to guard against swelling, and the obstruction of the circulation. Sometimes the extremity being placed in a new position will very much retard the flow of blood through the artery. Sometimes the deformity must be corrected gradually on this account.

All wounds must be antiseptically dressed, and the extremity, if possible, placed in the most desirable position, and retained there with splints and bandages. In favorable cases the plaster of Paris dressing may be applied over the whole extremity, as a splint and it acts as a sedative for the subsequent inflammation.

For ultimate success the full co-operation of the patient must be obtained, and he must be told that passive movements must be steadily persevered in, at first, at intervals of about a week, and nearer together as time passes. Each movement, even though painful, must be complete, as the ultimate result will be only in proportion to the movements that have been kept up in the joint.

Treatment of Bony Ankylosis. As stated before, the improvement expected by treatment of bony ankylosis is generally only an improvement in the position of the extremity. The position is improved by operation. A linear or wedge-shaped osteotomy is performed and union allowed to take place in the improved position.

Some operators have succeeded in securing a movable joint, after cutting the bone and dressing the extremity in the improved position. (Sayer.)

The operation is sometimes performed sub-cutaneously, and sometimes by the open method.

SECTION V.
SPECIAL JOINT DISEASES.

CHAPTER I.

HIP-JOINT DISEASE.

Definition—Etiology—Sprains, Acute Arthritis, Tuberculosis; Pathology—
Changes in Ligaments, Bones, Synovial Membrane, Cartilages, Muscles,
Abscess; Symptoms—Lameness, Deformity, Pain, Night Cries, Fever,
Abscess; Diagnosis—From Symptoms, History, Examination; Differential
Diagnosis—Periarticular Affections, Sacro iliac Disease, Lumbar Pott's
Disease, Congenital Dislocation of the Hip, Infantile Paralysis, Hysterical
Affections.

Hip-joint disease is a chronic inflammation of the hip
joint. It involves the bone in the form of an osteitis, and in
some cases goes on to necrosis and suppuration.

It is by far the most frequent lesion of the hip and by
common usage the name hip-joint disease has been adopted.
It is known also as *Morbus Coxarius*, *Coxalgia*, *Coxitis*, *Chronic
Articular Osteitis of the Hip*, *Osteitis of the Head of the Femur
and Tuberculosis of the Hip-joint*.

It is usually a disease of childhood, although young adults
may suffer from it. Ordinarily only one hip is diseased, but
in rare instances both hips may become affected.

Tabulated reports show that the disease occurs more fre-
quently in males than in females. (Ashhurst, Wright, Holt.)

Etiology. There are three general conditions that may
be followed by hip-joint disease; sprain, acute arthritis, and
tuberculosis.

Sprain at the hip is most often produced by violence in
jumping, or slipping. Many cases can be traced to a slip or
fall on the ice, in which the ligamentum teres was ruptured,
or other violence done to the joint structures. In this con-
nection it may be said that many cases of hip disease occur
in the robust and active children who romp and play violently.

The sprain is produced, and from the nature of the injury and neglect in treatment, it necessarily passes into a chronic state of joint disease.

Acute arthritis arising as the sequel of other diseases, as described in section IV, is in some cases the beginning of a protracted hip-joint disease. The acute symptoms may partially subside, but the arthritis has produced a disturbance in the circulation, or deposits in the joint so that destructive changes must follow.

Tubercular infection may take place in a joint and tuberculosis develop as a primary pathological affection, or the tubercular infection may occur after the joint has been
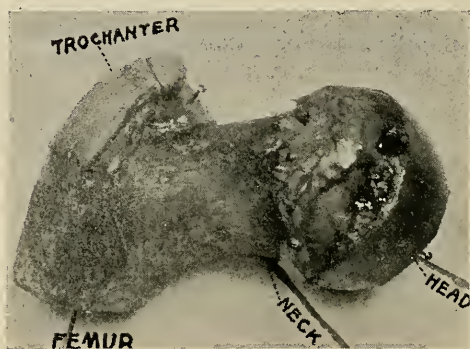
Fig. 108.   Bone removed in excision of the hip, showing necrosis.

inflamed from sprain or acute arthritis. In either case the bacilli of tuberculosis are said to be present in the system (hereditary or acquired), and find their way to the joint structures through the circulation. (See Tuberculosis, Sec. IV, Chapter IV.)

Pathology, In hip-joint disease, the early pathological changes are influenced greatly according to the causes and the anatomical construction of the joint.

Cases which are caused by sprain, where the ligamentum teres and its accompanying blood vessels are ruptured, thereby diminishing or cutting off the blood supply to the head and neck of the femur, besides the hemorrhage into the joint cavity, and the irritation produced by the injury, are most

liable to be followed by necrosis of the upper part of the femur.

No doubt nature endeavors to furnish provisional collateral circulation to repair the injury, yet her efforts are at an anatomical disadvantage. Irritation and minor injuries from exercise, place the parts at a greater disadvantage in making the necessary repairs to prevent necrosis.

Later, if the case progresses, all the structures entering into the formation of the joint, become involved in inflammatory changes, principally from the atrophic disturbance in the head and neck of the femur.

In cases of hip diseases, that have their origin as an acute arthritis from infection, the early pathological changes will vary according to the nature of the poison. The synovial
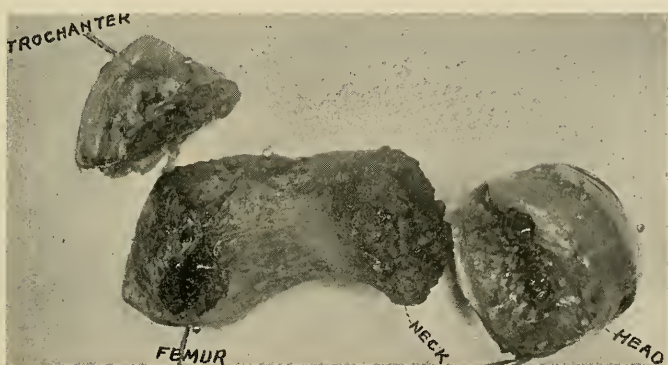
Fig. 109. Same as Fig. 108. Separation of the head and great trochanter from the effects of hip-joint disease.

membrane offers the most convenient receptacle for the microbes or their products, and an acute synovitis is the result. The joint cavity is rapidly filled with serous, sero-purulent or pyogenic fluid. The synovitis is accompanied by definite symptoms, and if it becomes chronic, degenerative changes in the bone or necrosis is the result.

In tubercular infection of the hip-joint, the deposit most often takes place in the bone. The primary focus of disease may be either in the acetabulum or in the head of the femur, or it may be in several places in both bones. At an advanced

period in hip-joint disease, it is difficult, even by inspection of the joint structures, to determine the original focus of the disease, as the whole joint becomes involved in the pathological process. Infiltration, ulceration, granulation and the separation of the articular cartilages from the underlying bone is the rule.

Fig. 110. Skiagraph of a case of protracted hip-joint disease in which spontaneous fracture occurred.

The strong muscles around the joint are stimulated to contraction to guard the joint against injury, and in some cases there is a degree of pressure necrosis from the femur being pressed hard against the acetabulum. The muscles of the whole extremity exhibit a degree of atrophy from diminished circulation and non use.

The formation of an abscess constitutes a disagreeable feature in connection with any case. It sometimes, in cases

of acute arthritis, forms early; in tubercular cases it may be a late complication, while many cases run a protracted course without infection and the formation of pus.

Where an abscess forms, the periarticular tissues become involved, and the pus gradually accumulates under the skin.

Where there is pyogenic infection of the hip-joint, the trochanters and the rim of the acetabulum prevent perfect drainage of the joint cavity and the destruction of tissue is thereby very much increased. Suppurative cases, if left to themselves, usually continue until the greater part of the head and neck of the femur, and a portion of the acetabulum form into sequestra and come away with the discharges.

Symptoms. The early symptoms of hip-joint disease will vary according to the circumstances attending the onset of the affection.

As the largest number of cases follow sprain, the history of some injury may be expected. The symptoms of lameness following, vary according to the severity of the injury. Usually the child is running about in a few days, as though no injury had been sustained. For months he may continue his exercises, whatever they may be, with only a slight lameness or stiffness of gait, which, as a rule is not sufficently marked to attract the serious attention of the parents.

Lameness. The child may be noticed to limp at times, and at other times to be comparatively free from lameness. The lameness increases, and in walking the patient will be inclined to strike the ball of the foot on the ground rather than the heel. The knee is slightly bent and the heel raises when the weight of the trunk falls on the hip. In standing, the patient throws the body weight on the well extremity, while the other leg and foot is placed a little farther forward. These symptoms are more noticeable in the morning or after sitting for awhile, than they are later in the day, or after the child has been exercising.

Deformity. Upon inspection, with the child stripped and standing, it can be noticed that the natis upon the side of the lameness drops a trifle, is somewhat flattened, and the

gluteo-femoral crease is lower and shallower than upon the well side. This occurs in consequence of the child favoring the diseased side in walking and standing. As he walks the stiffness at the hip can be seen.

Fig. 111.　Hip-joint disease, arising from acute arthritis.
Shortening from the tilting of the pelvis.

In many of the cases that arise from acute arthritis, and in severe or advanced cases the symptoms are quite different.

The patient may be confined to the bed from the beginning, or only able to move about by the assistance of crutches. The joint is very sensitive to any attempt at using it, and in chil-

Fig. 112. Same case as Fig. 111. Front view.

dren, the muscles have fixed the extremity in a position of marked adduction or abduction and flexion

There is usually the appearance of shortening of the extremity which arises from the tilting of the pelvis. In some cases there may be the appearance of lengthening, but if
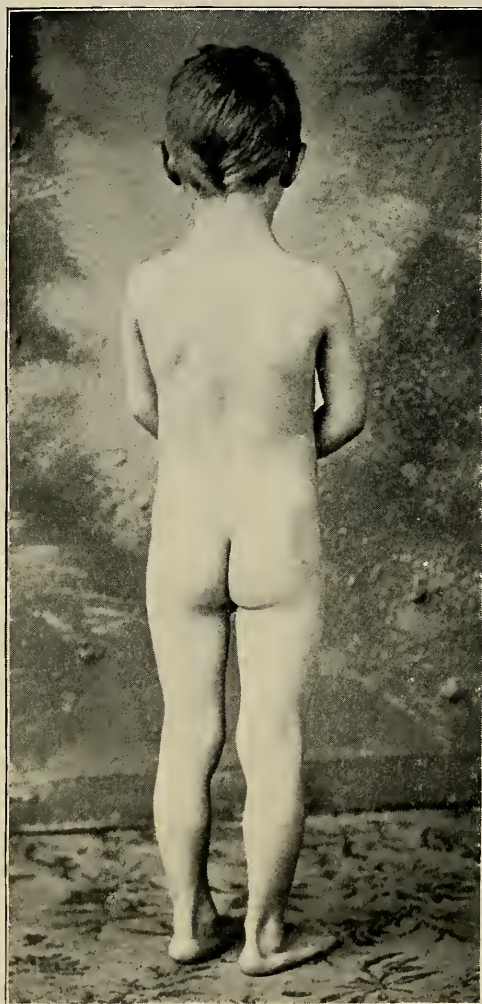
Fig. 113. Earliest signs of hip-joint disease in the left hip.

measurements are taken, the extremities will be found to be of the same length unless the disease has existed for years during the growing period, in which cases there is usually

an arrested growth of the extremity. If the disease occurs
in adults, the adduction or flexion is not so liable to be
present, especially in bedridden cases.

Atrophy of the muscles of the whole extremity is usually
quite an early symptom, and is most marked in the severe
cases.
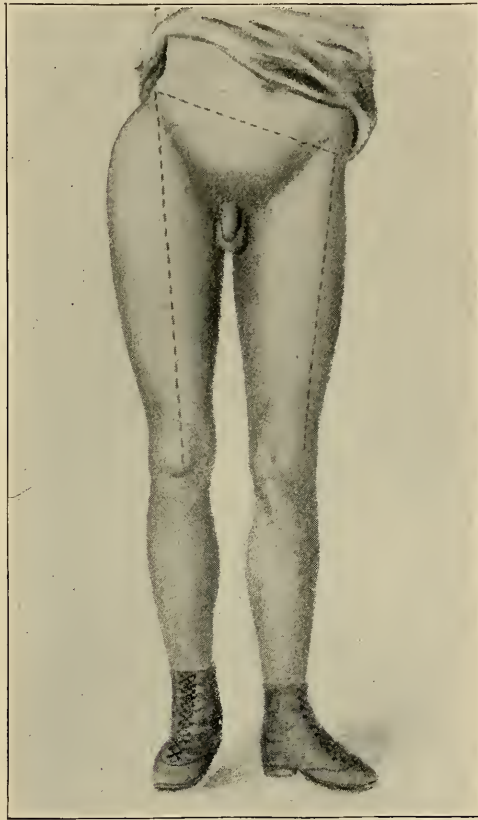
Fig. 114.   Showing tilting of the pelvis usually present in
hip-joint disease.

Pain.   The pain is a varying symptom of hip disease. It
may be absent at any or all times in some cases, or it may
form one of the distressing symptoms. Usually as the dis-
ease progresses the pain will be felt in or near the knee. The

patient rarely complains of pain about the hip, unless an abscess is gathering under the skin.

The patient unconsciously protects the joint against injuries. In severe cases, in the movement, the foot of the well limb will be placed under the lower part of the other leg when it is to be suddenly lifted.

Manipulation may produce pain, or in other cases the joint may be perfectly stiff by muscular spasm, so that manipulation is painless. In some cases a certain arc of motion can be described without producing pain, but when the limit is reached, further motion becomes painful and is prevented by muscular spasm.

Night cries. At any time during the course of the affection, night cries may be a distressing symptom. After the patient is asleep and to all appearances entirely unconscious, sleep will be interrupted by a loud cry, as if from severe pain, followed by moaning or crying for a few seconds, and then the child is sound asleep again. The cry is caused by the spasmodic twitching of the muscles while asleep, and may vary from a short moan to a sharp shriek. It may be absent in the milder cases.

Fever. During the active stages of hip disease the temperature will vary from normal to 102 degrees Fahrenheit. Early in the affection the thermometer will register a fluctuating temperature of one to three degrees above normal. At any stage in the course of the disease when the temperature remains normal for a week or two, it may be regarded as favorable, and a desirable condition to be accomplished. A fluctuating temperature with chills and fever, coated tongue and sweats may be regarded as evidence of abscess.

There is often observed a tendency to remission of the fever during the course of the disease. To outside appearances, a case may seem to recover from the distressing symptoms for a time and afterwards they return with increased vigor. It is well not to be deceived by this temporary improvement. A careful study of all the symptoms should be made for some weeks before concluding that permanent improvement is taking place.

Abscess. Many cases run a protracted course without the formation of an abscess. It is usually in neglected and infective cases that it occurs. As a rule it has its origin within the capsule of the joint. Finally the pus penetrates the capsule and may be entirely absorbed by the soft tissues into

Fig. 115. Favorable result following supprative hip-joint disease.

which it escapes. Generally, however, it slowly follows the sheaths of the muscles, and the fascia, appearing later as a secondary abscess with numerous fistulous openings, discharging pus and serum for months or years.

Pus may collect under the skin, forming a fluctuating tumor. Its most usual location is just below the joint at the anterior border of the tensor vaginæ femoris muscle. It may form posteriorly at the lower border of the gluteus maximus; or it may reach the inner side of the thigh in front of the adduc-

Fig. 116. Front view of Fig. 115, showing abscess scar.

tors or it may open into the rectum, or above Poupart's ligament.

Diagnosis. The diagnosis of hip-joint disease is easy in some cases and difficult in others. When the symptoms— lameness, deformity, atrophy, pain, night cries, fever and

abscess are at all conspicuous, a diagnosis can be made at a glance.

Many times the symptoms are not sufficiently plain and gross errors are made in the early recognition of the disease.

The symptoms that are present in all cases are lameness, deformity and a variation in temperature.

The lameness is peculiar, but it may exist in connection with other troubles. The same is true in regard to the fever.

The deformity, in some cases scarcely noticable, is the principal feature upon which to base a diagnosis. The particular part of the deformity to be taken into consideration is the stiffness at the joint—the muscular rigidity.

The muscular stiffness at the hip can best be determined by stripping the patient and using gentle manipulation of the extremities, while the patient is lying on the table.

The patient should be placed on his back, and flexion and extension made to determine the degree of motion at the hip. Flexion should be made with one extremity, then the other, and it will be noticed that on the diseased side the pelvis moves with the thigh, while on the well side the motion at the hip-joint is free.

Rotation of the head of the femur within the acetabulum should be tried by turning the foot from one side to the other —abduction and adduction. The thigh should be flexed and then rotation tried. In the very earliest stages of hip disease, an unusual resistance to this motion will be found on the affected side, as compared with the normal side. A catch in the motion of the joint in any part of its arc is suspicious, and any considerable degree of fixation may be regarded as almost pathognomonic of hip disease.

In making these tests in young children who are liable to be frightened, much care must be exercised to determine between the muscular stiffness, and the voluntary efforts of the child to resist manipulation. Gentle movements of the extremities with the child in different positions will probably determine limitation of motion.

The history of the case will be of great assistance in forming a positive diagnosis. A history of a slight lameness cover-

ing a period of many months, which possibly was preceded by a sprain, or some of the common diseases, which was followed for a short time by an acute inflammation of the joints.

It is well to take into consideration the family history, as it would have a bearing in establishing the fact as to whether the disease was tubercular or not.

The diagnosis of deep abscess is made with considerable difficulty. When pus is present, the symptoms are usually severe—limited motion, pain, night cries, chills and fever, with a coated tongue, etc. A careful study of these symptoms for a few days, should enable one to make an early diagnosis of pus within the cavity of the joint.

Differential Diagnosis. Many mistakes have been made in the diagnosis of hip-joint disease by physicians not being familiar with the symptoms of the affection.

The differentiation of sprain and acute arthritis can readily be made from the history. The same is true of all other acute troubles. There is hardly any excuse for a case of hip disease being diagnosed as rheumatism.

The principal affections which are to be differentiated from hip-joint disease, are:

1. Periarticular affections.
2. Sacro-iliac disease.
3. Lumbar Pott's disease.
4. Congenital dislocation of the hip.
5. Infantile paralysis.
6. Hysterical affections.

1. Periarticular affections which have not yet attacked the joint, are recognized by the fact that the disease invades only certain groups of muscles, causing a limitation of motion, greater in one direction than in another. Under this head may be included inflammation of the bursæ and lymphatics, psoas abscess, caries of adjacent bones and osteosarcoma.

2. Sacro-iliac disease differs from hip disease, in that the seat of greatest tenderness is different. If the pelvis is fixed, there will be easy motion at the hip. In walking, the patient inclines the body to the opposite side, and the thigh is not drawn toward the pelvis, as in hip-joint disease.

3. Lumbar Pott's disease, is sometimes differentiated with difficulty, but the point to determine is the location of the rigidity of the muscles. In lumbar Pott's disease, it will be found to be in the back. While the psoas and iliacus muscles may be involved, thus affecting the movement at the hip, still as a rule, abduction can be easily made. In some cases, time must be given, with repeated examinations, in order to make the differentiation.

4. Congenital dislocation of the hip is differentiated by applying Nelaton's test, or determining that the lameness has existed from the time the child began to walk. The free mobility at the joint will exclude hip-joint inflammation.

5. Infantile paralysis in its initial stage, may closely resemble the early symptoms of hip-joint disease. In time, however, there is great mobility at the hip. The tottering walk, absence of reflex muscular spasm and the absence of the electrical reaction, aid in the diagnosis.

6. Hysterical affections, often require much skill and care in making the examination in order to be positive of the differentiation. In some instances, in hysterical affections, there will be a temporary relaxation of muscular spasm, when the patient's attention is diverted.

During the usual examination, the hip may be found very stiff, but after the examination is completed, and the patient is dressing, it may be seen that considerable motion exists at the joint. The movements of the patient must be observed in sitting, moving, crossing the limbs and buttoning the shoe, etc. The patient will unconsciously make motions that would be impossible with organic disease of the hip-joint.

CHAPTER II.

HIP-JOINT DISEASE (CONTINUED).

Prognosis—In Early Stages, In Advanced Stages; Treatment—Recumbency, Extension, Mechanical Treatment, Operative Treatment, Iodoform Injection, Excision; Treatment of Hip Ankylosis—Myotomy and Tenotomy, Osteotomy, Grant's Operation.

Prognosis. The prognosis is unfavorable if left to a natural course. If properly treated, it can be cured in the early stages without deformity remaining, but with more or less deformity, if the case is well advanced before treatment is commenced.

The natural course of the disease is tedious—covering a period of three to six years, and if a cure is brought about, it is with much deformity remaining. The course of the disease can be very much shortened and the degree of the deformity very much lessened by efficient treatment. During such a protracted sickness, many complications arise which may increase the danger or cause a fatal termination.

When the disease occurs after puberty, it is more extensive and more fatal than when it occurs at an earlier period.

Cases that arise from infection, in the form of arthritis, run a more rapid course and are much more severe than those from sprain. The same disorders that produced the hip disease may be present in other organs and tissues of the body, and the vital forces may be much lowered by their presence.

The formation of abscess is always an undesirable feature in a case, as it means the destruction of much tissue, and subjects the patient to the dangers of secondary infection from without. It may be said, that as a rule, the cases that are fatal are those which suffer from a mixed infection, and disease attacks other joints or other parts of the body, as the lungs, kidneys, or spine.

Some cases result in spontaneous cure, and when this occurs, it is usually with bony ankylosis.

When the disease has existed during childhood, the growth of the extremity is arrested, and shortening remains, together with more or less loss of function of the hip-joint.

Mild cases can be cured with free motion at the joint, and little or no shortening, but severe and protracted cases inadvertently result in shortening, flexion and fixation.

The time necessary to effect a cure in well marked cases is from one to three years. The early discontinuance of treatment is a serious mistake, as relapses are liable to occur and be disastrous to the patient. It is better to continue protective treatment too long than to run the risk of having a relapse by its discontinuance. If the case is treated early, all the symptoms will gradually disappear as it improves, and it is well to continue this treatment for one year after apparent recovery.

Treatment The treatment of hip-joint disease may be considered under three headings:

1. Recumbent.
2. Mechanical.
3. Operative.

1. Recumbency is one of the best methods of securing complete rest to the diseased joint. It is well to confine the child in bed for three or four weeks at the beginning of even early treatment, as we know of no plan of treatment that will do more good for a time, than complete rest in bed. It also gives good opportunity for studying the case independent of any influence from exercise.

If the deformity be slight, with no pain or night cries, recumbency, without extension will suffice. Most cases, however, will find great relief from bed-extension.

Bed-extension can be accomplished by the use of " Buck's extension " as employed in the treatment of fractures of the femur. It is fastened to the leg by adhesive plaster and extension made by a rope over a pully at the foot of the bed with a weight attached.

The amount of weight to be applied should be sufficient

to relieve the child and keep the extremity straight. Probably about one pound to each year of age. After the recumbency treatment has been used awhile if the symptoms show an improvement, mechanical protection can be used by day and bed-extension by night.

A combination of bed-extension and mechanical protection may be had in the use of the bed-frame with the traction apparatus added.
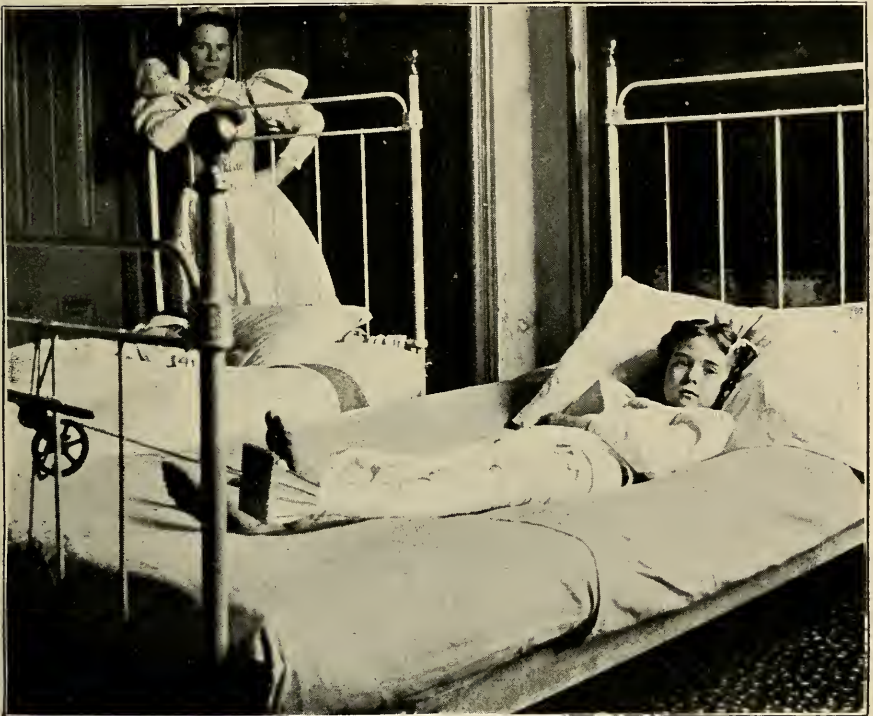
Fig. 117. Bed extension used in recumbency treatment, or after excision of the hip-joint. Same case as Fig. 113, after excision.

2. Mechanical treatment consists in using some form of brace or fixation apparatus, either with or without extension, in such a manner as to allow the patient to move about some during the day time without producing friction at the hip. As good an apparatus as any is the long hip splint. (Fig. 118 and Fig. 119.)

The brace or splint is made without joints from the hip to the shoe, so that if desired, extension can be made between the pelvis and the foot. An extension of one inch is placed on the bottom of the shoe of the well foot so that the lame ex-
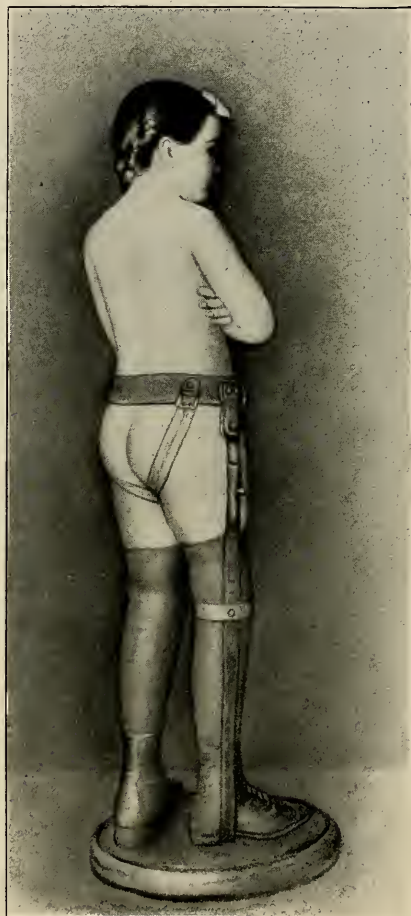
Fig. 118.   Mechanical treatment by long hip brace.   A thick sole is placed on the heel of the well foot.

tremity will swing without striking the toe on the ground as the child walks with crutches.

This treatment should be persisted in for a long time, in conjunction with improved hygiene, generous diet, sufficient

sleep and such constitutional medication as the general condition of the case may demand.

The recumbent and mechanical treatment will produce a cure in many cases, especially if it is mild, or if there is no
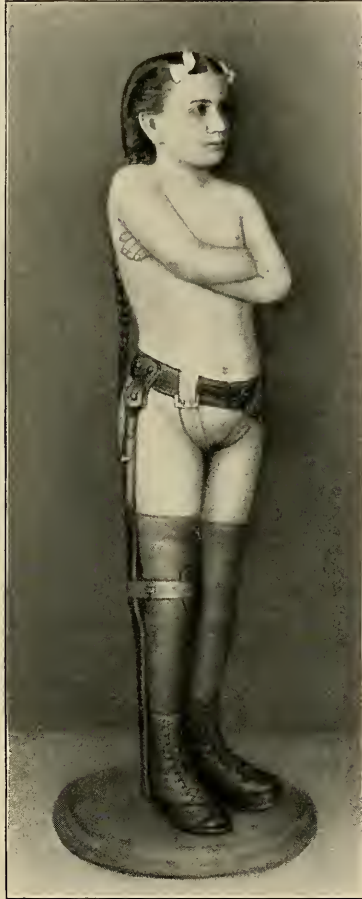
Fig. 119. Same case as Fig. 118. This apparatus is also suitable for protection after excision of the hip.

abscess present. When, after a reasonable trial of this treatment, no satisfactory progress towards recovery is evident, resort should be had to operative treatment.

3. The operative treatment most effectual in the relief of hip-joint disease is injection and excision.

Operative Treatment. *The injecting of iodoform emulsion* in or about the joint is considered by some as effectual in the cure of many cases. If the capsule of the joint is filled with fluid, it is well to withdraw it with the aspirator. Many times the aspiration of a joint will relieve the pain, and do much toward promoting improvement, especially in those cases that arise from arthritis. The iodoform emulsion can be introduced through the needle of the aspirator if desired. All antiseptic precautions must be taken in this operation.

The best point to be selected for the introduction of the emulsion into the joint is described by De Vos as follows: " A line is drawn from a point, the breadth of the patient's thumb, external to half way the distance from the anterior superior spine of the ilium to the pubic spine. From this point another line is drawn to the outer edge of the tro-chanter major. At the junction of the outer and second fourths of this line, the needle is introduced, provided the limb is extended, the foot vertical and the trochanter in its normal relation to Nelaton's test line." The needle can also be introduced into the hip-joint by puncturing just behind the great trochanter.

The hip is then immobilized by plaster or other suit-able dressing, and the child kept in bed for one week, when the injection is repeated.   (See Sect. IV, Chap. V.)

As soon as it is found that the disease is progressive, re-sort is had at once to excision, not waiting for greater de-struction. Where the inflammation is extensive, with necro-sis and danger of abscess, then the longer the excision is deferred, the more bone it will be necessary to remove, and the greater the consequent deformity.

Excision or Resection of the Hip-Joint. The *modus operandi* in excision of the hip is as follows: The anæsthetized patient is laid upon his side upon the operating table with the affected hip uppermost. The hip and knee joints are slightly flexed, and a cushion is placed between the knees. The body of the patient is carefully protected against wetting and expos-

ure by rubber sheets. The hip and buttocks are shaved, scrubbed, and disinfected, and the field of operation protected with sterilized towels.

A curved incision, commencing at a point about two or

Fig. 120. Line of incision in excision or resection of the hip-joint.

two and a half inches above the tip of the trochanter major, is made, and extended downward, backward and forward, to a point about the same distance below the tip of the trochanter, and over the shaft of the femur. The incision is curved, with its convexity posteriorly, and should reach the bone. The knife

or the periosteal elevator should now be used to expose the
trochanter.   At this juncture of the proceeding, the diagnosis
can be confirmed by making an opening into the cancellous
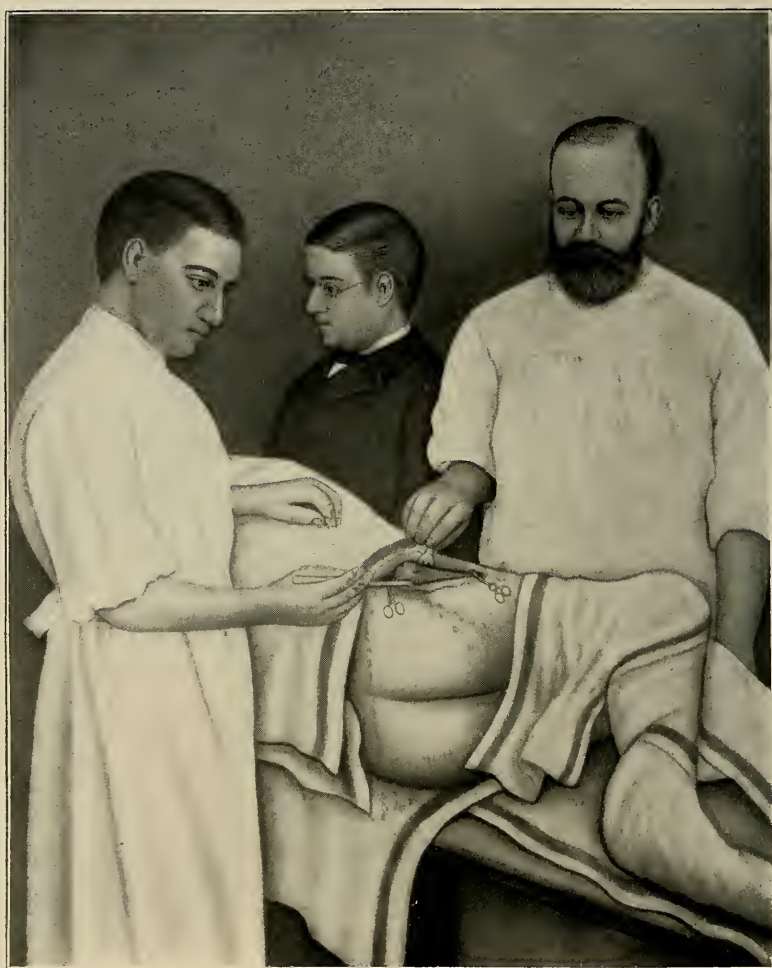
Fig. 121.   Showing detail of the operation of excision of the hip-joint.

tissue and observing the condition of the bone. In nearly
every case evidence of caries can be seen under the surface
of the great trochanter.

The operator continues the dissection until he can pass

his finger around the femur above the trochanter minor. He
then passes a chain saw around the bone and saws at about
right angles with the shaft of the femur. After the bone is
divided he grasps the sawed off portion, and by a few sweeps
of the knife closely hugging the bone, the head of the femur
is quickly and easily dislodged.

Fig. 122. Case from which the bone in Fig. 107 was resected,
showing result six months after the operation.

The capsule is carefully excised with scissors and forceps,
and with a sharp curette all fungus and necrotic tissue is
thoroughly scraped away, while cut vessels are immediately
seized and ligated. The acetabulum is scraped, and if necro-
sis is found, the dead bone is also thoroughly removed. The

sawed off end of the femur is examined, and, if there is evidence of necrosis remaining, the periosteum is peeled off, and section after section of the bone removed until sound and healthy bone is reached.

If the case is one with pus cavities and sinuses, as soon

Fig. 123. Same case as Fig. 122, eight months after operation, showing flexion.

as these are opened, they should be thoroughly cleansed by irrigation with an antiseptic solution, before proceeding farther with the operation. All fungus or pyogenic secreting tissue or membrane should be thoroughly cut and scraped away, the cavity of the wound irrigated and made as clean as a newly incised wound.

Silkworm gut sutures are inserted one-third of an inch apart, and, before they are tied, the wound is loosely packed with iodoform gauze. An ample dressing is applied, the patient put to bed, and a weight and pully extension apparatus put on. The patient's legs should be supported by sand bags or a blanket splint.

Fig. 124. Showing good results four years after excision of the hip-joint.

Thirty-six hours after the operation the iodoform gauze should be removed, and a small piece placed in the mouth of the wound, and fresh dressings applied to remain until the seventh day, when the sutures should be removed. In many cases the wound heals readily without the formation of pus.

If suppuration should re-establish itself in the wound, then a frequent redressing and irrigation are necessary. Should exuberant granulations or fungus tissue appear in the wound, these must be thoroughly scraped away.

During the after treatment, the limb must be kept fully extended and somewhat abducted. In a few weeks, or as

Fig. 125. Same case as Fig. 124, showing flexion and rotation in the hip.

soon as the wound is nearly or completely healed, a modified Sayer apparatus should be applied and the patient should be permitted to exercise on crutches. As his strength permits he can exercise the extremity, and by degrees acquire the use of it in walking. The use of the supporting apparatus should be continued for months, or until the patient has complete control over the extremity.

Ankylosis following Hip-Joint Disease.

If hip disease receives the proper treatment during the course of the affection, the deformity remaining after recovery

Fig. 126.   Deformity that usually follows untreated cases of hip-joint disease.   Bony ankylosis.

seldom requires any treatment, except to lengthen the shortened extremity by an extension on the sole of the shoe.

There are many cases where extension and protection are

not used; and when recovery takes place, the thigh is badly flexed and ankylosed in an almost useless position.

When the extremity is left in such a position as to be useful to the patient in walking, with no great deformity, the ankylosis should not be interfered with, for fear of causing a relapse of the old disease. If, however, the ankylosed position is such as to be a great impediment, and it is made sure that the hip-joint disease has completely subsided, then operative treatment to improve the usefulness of the extremity may be considered.

Myotomy and tenotomy are best performed on the hip by the open method. The rule is to divide all the shortened muscles and tendons. Those requiring division are usually the tensor vaginæ femoris, fascia lata and the intermuscular ligaments.

In some cases the psoas and iliacus muscles may require division. Barwell states that he has had good results following the extensive division of muscles and fascia; and other operators have excised adipose tissue and skin.

After myotomy and tenotomy, the limb should be brought into the corrected position, manual force being used if necessary. The wound is then to be closed in the usual manner and immobilization and extension employed until all sensitiveness has disappeared from the joint.

Osteotomy is to be performed where bony ankylosis exists with great deformity. (Ashurst's Surgery.) It consists in dividing the bone near the joint, and after bringing the extremity, into a useful position, allowing it to reunite on the same principle as in fractures. (Sayer, Adams, Grant, Volkman.)

Some operators (Barwell, Munde, Le Dentu), have sought to make a movable joint at the point where osteotomy has been performed, by using passive motion from the fifteenth day after the operation.

The result has not been generally satisfactory, as the new joint has proven weak and unreliable. On the other hand, if the bone is allowed to reunite, the mobility of the pelvis compensates for the loss of motion at the hip.

Osteotomy varies considerably as performed by different operators. Barton excised a wedge-shaped piece of bone from between the trochanters. Sayer sought to imitate the ball and socket joint by removing a semi-circular piece of bone; Adams divides the neck of the femur through a small wound; while Grant divides the femur below the trochanter minor.

Of all the plans suggested, some modification of Grant's operation seems to have the precedence. It can be performed as follows: An incision is made from the tip of the great trochanter, downward over the bone. The muscular attachments and periosteum are raised with the periosteotome just below the level of the trochanter minor. Then the bone is divided. A chisel, saw, or osteotome, that will do the work without injury to adjacent blood vessels can be used. A partial division of the bone can be completed by fracture, if thought best. The hemorrhage is then arrested, the wound closed and the extremity placed in a normal relation to the pelvis. If resisting muscles and tendons are found, they should also be divided.

The subsequent treatment is similar to that of a fracture. Extension and immobilization should be maintained until union takes place between the bones, or if nearthrosis is desired, passive motion should be commenced in about fifteen or twenty days after the operation.

CHAPTER III.

KNEE-JOINT DISEASE.

Definition—Etiology—Pathology—Symptoms—Lameness, Pain, Swelling, Deformity, Heat, Abscess; Diagnosis—Differential Diagnosis—Bursitis, Rheumatic Arthritis, Hysterical Affection, Osteosarcoma; Prognosis—Treatment—Plaster Cast, Mechanical Apparatus, Recumbency, Operative—Ankylosis.

Knee-joint disease is a chronic inflammation of the knee-joint, involving the bone and synovial membrane.

It is also known as *Tumor Albus, White Swelling of the Knee, Tuberculosis of the Knee, Tubercular Osteitis, Tubercular Synovitis of the Knee* and by other names.

It makes its appearance as frequently in males as in females and may occur at any time of life.

Etiology and Pathology. Knee-joint disease has its origin either from a sprain, an acute arthritis, or as tuberculosis. Entering into detail here would simply be a repetition of what has been said upon those subjects in another part of the work.

It is well to bear in mind, however, that the knee is the largest and most exposed joint in the body. Its synovial membrane and the articular surfaces of the bone being so extensive, that when attacked by disease under unfavorable circumstances, its manifestations are severe and the tendency towards a chronic course is great.

A large amount of fluid contained for a long time in the synovial cavity has a tendency in most cases to increase the joint destruction. Owing to the large size of the condyles and head of the tibia, it is not uncommon to find extensive osteitis with sequestra of considerable size. An osteitis occurs in the femoral and the tibial portions of the joint with equal frequency. In rare instances the patella is attacked.

Whatever the cause, and wherever the disease begins, the ultimate result in the joint is likely to be the same, a

destructive osteitis, fungus ulceration and a tendency to purulent discharges, with deformity, as the result. It may end in complete destruction of the joint, or in arrest of the disease with cicatricial recovery.

Symptoms. The early symptoms of knee-joint disease may vary according to the cause of the affection.

In sprain we have the history of the injury, followed by sensitiveness for a time, and then for a time an improvement, then a relapse of the sensitiveness, and lameness. There may have been several exacerbations covering a period of many months, until finally, a chronic sensitiveness and lameness remains. These gradually grow worse until characteristic symptoms are manifested.

In acute arthritis there are the symptoms of an acute synovitis—pain, swelling, fever and change of function, which in some cases, although not severe, produce sufficient disturbance of the structures, to permit of relapses after any unusual exercise.

In severe or suppurative arthritis, the destruction of joint tissues are more rapid and the symptoms of severe knee-joint disease develops in a comparatively short period of time.

If the disease begins as a tubercular osteitis of the epiphyses, its onset is, as a rule, very insidious. A slight pain or stiffness, a slight limp in walking, which is transient, or recurrent, disappearing after a night's rest, marks the gradual onset of this grave malady.

While there is a destructive advance of the local process, the symptoms assume a more positive character. A decided limp, intermittent pain, swelling of the joint, a change in the appearance of the skin, defective joint movement and muscular wasting, with marked constitutional disturbance, indicate the true character of the morbid affection.

Lameness. The lameness is a constant symptom and varies from that of a slight limp to that of a total loss of the use of the extremity. It is due principally to the sensitiveness within the joint, mostly in the bone. In cases of long standing the lameness is increased by the deformity, as the joint

becomes partially ankylosed in a flexed position, thus bear-
ing the body weight very unnaturally.

In some cases a subluxation, or an enlarged internal
condyle, adds to the amount of disability and increases the
limp.

Pain. The pain in the knee varies from that of slight
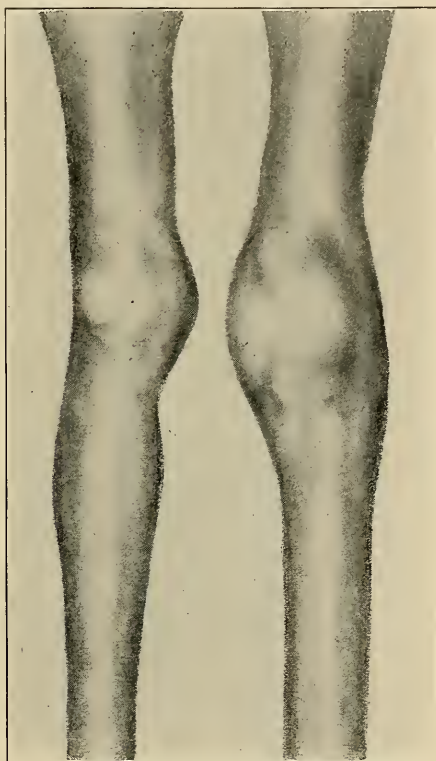
Fig. 127.   Knee-joint disease where the affection is confined
to the bone.   Tubercular Foci.

paroxysms, to a dull aching or gnawing pain, produced or
increased by jarring. In some cases it is excruciating.
Night cries, are present in some cases.

Tenderness on pressure is present, the most tender spots
being over the internal condyle, and over the coronary liga-
ments, or the inner side of the head of the tibia.

Swelling. The swelling of the joint is characteristic. The normal joint depressions are filled out, and the general tumefaction with an indistinctiveness of outline, gives an appearance that cannot be mistaken.

The joint appears more swollen on account of the atrophy

Fig. 128.   Hydrops of the knee-joint.   Side view.

above and below it.   The skin is usually pale and glistening; the surface feels soft and doughy.   Fluctuation may, or may not be present.

Deformity. Muscular fixation is the principal element in the production of the deformity. The joint may be held perfectly rigid in the extended position, or it may be partially flexed—usually the latter.   In some cases there may be a

limited arc of motion, but beyond the limit the muscles quickly catch the joint and prevent it from going further.

Persistent muscular spasm results in flexion, subluxation and external rotation of the tibia. It may be very gradual, but as the bone and other joint structures become involved it steadily increases. If the case goes on without treatment, the flexion and fixation may become extreme. This is the tendency of the disease, and the chief obstacle to contend with in the treatment.

Sometimes when the disease seems nearly cured, a slight imprudence on the part of the patient is likely to bring back the flexion, which is accompanied by increased heat and pain in the joint.

Heat. An increase in the temperature, both locally and generally, indicate an active inflammation going on. In some cases, however, even though the bone may be involved, extensively, there may be a coolness of the surface over the joint.

Abscess. In some cases an abscess forms as the result, generally, of a purulent distention of the capsule of the joint. In some cases it is a typical cold abscess. It may point at any place around the joint, and discharge by sinuses for an indefinite length of time.

Diagnosis. When knee-joint disease is well established, there is no difficulty in making the diagnosis. The characteristic symptoms of lameness, pain, swelling, deformity, heat and abscess in the knee are conclusive.

The diagnosis must at times be made early, or before all the above symptoms are manifest. If the disease is osteopathic, the diagnostic symptoms may be only those of deformity —stiffness on movement, and atrophy of the muscles above and below the joint. When this condition is observed, examination should be made by making pressure over the condyle, coronary ligaments and the head of the tibia. If tenderness is found, it may be considered that disease of the bone is present.

The author considers this test of great service, not only in making an early diagnosis, but also in determining whether or not a case has recovered sufficiently for treatment, to be

discontinued. As long as this tenderness remains, treatment should be persisted in.

Differential Diagnosis. The chronic diseases that are to be differentiated from knee-joint disease are periarthritic affections, rheumatic arthritis, hysterical affections and osteosarcoma.

Periarthritic affections.—Bursitis and other inflammations, with or without abscess outside of the knee joint, are to be distinguished by their position, their relation to the patella, and the absence of muscular spasm, atrophy, and joint stiffness.

Fig. 129. Osteosarcema of the knee.

Rheumatic arthritis.—This affection resembles knee-joint disease, but with it is associated an arthritis of many of the other joints. It is most often found in advanced life, and is characterized by a roughness and crepitation not present in the true knee-joint disease.

Hysterical affection.—This pseudo-arthritis is found mostly in persons who present other symptoms of nervous disease. It can be distinguished from the true disease by

the absence of the characteristic symptoms. The pressure test will be of some assistance in determining its nature. If muscular spasm is present it is only periodical.

Osteosarcoma.—This affection, when occurring in the epiphyses, is attended by great pain and is more rapid in its development than an osteitis in knee-joint disease. The limitation of motion is, as a rule, due to the enlargement of the bone, checking the motion beyond a certain limit. Sometimes, however, it involves the articular cartilage in its rapid growth, and then there is spasmodic muscular contraction.

Prognosis. The prognosis in knee-joint disease may be said to be more favorable than it is in hip-joint disease. The osteitis is more superficial, and it is possible for an abscess to form and point externally without entering the cavity of the joint.

The termination will depend much upon the treatment received and the general surroundings of the patient. The general health, the nutritive condition, and the care of the patient are potent factors as regards the ultimate result.

In favorable cases, and when treatment is commenced early, the tendency is toward recovery with ankylosis. Some cases, however, recover with perfect use of the joint. The gradual amelioration of the constitutional and local symptoms—increased appetite, undisturbed sleep, improvement in the general appearance and a stationary condition of the local symptoms indicate the change for the better. The swelling subsides, the muscular stiffness gradually disappears and the joint sensitiveness passes away. If the disease advances, the destructive process is marked by an increase in all the symptoms. Finally, hectic fever is marked—with anorexia, scanty urine, night sweats and exhaustion. The infections from the joint suppuration produce secondarily, amyloid degeneration of the abdominal viscera or disease of the lungs and meninges, and finally death ends the scene.

Treatment. The treatment of knee-joint disease should be both general and local. The general constitutional treatment will include therapeutic, hygienic and such other measures as are indicated. Locally, the joint should receive such

treatment as will assist nature's forces to bring about a cure in the shortest possible time.

In the great majority of cases, the indication at all times will be for protection, fixation and extension of the joint. The protection or compression should be gentle and evenly applied to the joint in the form of a bandage of some sort. It acts greatly as a local sedative, prevents swelling, and is usually pain relieving.

There should be fixation at the joint, so that there can be no attempt at motion for certain periods of time. If motion is produced every week or two in these cases, it will serve the purpose of preventing ankylosis. Otherwise the joint and the extremity, from the ankle to the groin, should be kept in some form of fixation apparatus.

Fig. 130.   Plaster of Paris bandage applied to form a cast.

The extension necessary to accomplish the greatest good, is that which will simply counteract the muscular contraction. The action of the hamstring tendons and their muscles in producing a gradual flexion at the knee is often overcome with great difficulty. If bandages or an appliance fits the thigh evenly, making some pressure on the belly of the muscles, it will prevent muscular contraction to a considerable extent.

Plaster of Paris bandages applied to form a cast, from the ankle to the groin, are in the writer's hands, the best means of

treatment to fulfill the indications for protection, fixation and extension.

The plaster bandages should be applied to the skin. They should be of sufficient width and length so that they can be applied smoothly and snugly, making the desired pressure over the joint and the muscles. During the process of its applica-

Fig. 131. Adjustable plaster casts for the knee.

tion and hardening, an assistant should produce the desired extension and counter extension.

The plaster bandage should be applied and allowed to harden with the extremity extended as straight as possible without producing too much pain to the patient. Even

though there is some pain at the time of the application, it gradually passes away as the plaster hardens and the tissues become accustomed to the pressure.

Unless the plaster cast should produce pain from the formation of pus beneath, it should be allowed to remain on for a period of one to two weeks. Then, upon its removal, the joint can receive such treatment as is necessary and a plaster bandage be reapplied.

At this time a careful toilet is to be made of the extremity, flexion and extension carried as far as possible, and the application of medicine to the skin, or the injection of medicine into the cavity of the joint done, as seems best for the patient. Each time the plaster bandage is reapplied, an effort should be made to secure the extremity in a more extended position.

Absolute rest of the joint and non use of the extremity is to be enjoined in these cases, for a considerable length of time.

If a case is progressing favorably, it may be well to replace the plaster with some form of mechanical apparatus that can be more easily adjusted.

Mechanical apparatus for the knee. Probably the most available apparatus is that of a trough made to fit the extremity. It can be made of plaster of Paris, silicate of soda, leather, heavy felt, wood, and bandages, etc. It should cover the extremity from the ankle to the gluteal region, and it should be open in front so that it can be removed and reapplied at will. Such a splint is of great utility, especially if the patient is too poor to purchase the more expensive apparatus from the instrument manufacturers.

More elaborate mechanical apparatus which is used extensively, and which combines extension with fixation and protection, are the knee braces of Sayre, Shaffer, Young and Thomas.

Any complicated apparatus requires skill in its application, and constant attention on the part of the surgeon or attendant. It should do the work of fixation and protection, and at the same time be so adjusted as to counteract the

muscular contraction, and all this without causing the patient to suffer pain.

An advantage claimed for a knee-joint apparatus is, that during the time the patient is convalescing, the extension can be easily and gradually adjusted. The flexion at the knee can be gradually overcome by a daily increase of the pressure toward extension. Many times the tendency of the knee to become ankylosed in the flexed position is overcome in this way. It must be accomplished gradually and without much pain to the patient.
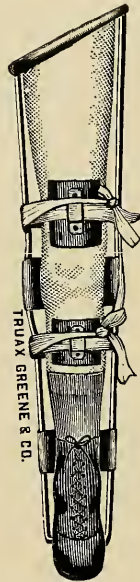
Fig. 132. Thomas' knee brace.

Apparatus as described above is especially serviceable, as by the protection which it furnishes the extremity against jars and injury, the patient is able to go about on crutches. By raising the sound limb by means of a thick sole, the affected limb is allowed to swing clear of the ground. It is important that the patient follow this line of treatment until all sensitiveness has disappeared from the joint. It is well

to be very cautious in beginning to use the extremity, as a relapse might occur from too free indulgence at first.

Recumbency. In very severe, and in suppurative cases, it is well to place the patient in bed for a time. It gives the physician a better opportunity of studying the symptoms and for completing his diagnosis and prognosis. The symptoms are often exaggerated by the fatigue from exercise. One of the surest preventives of suppuration is absolute rest. Recumbency combined with protection, fixation and extension, as
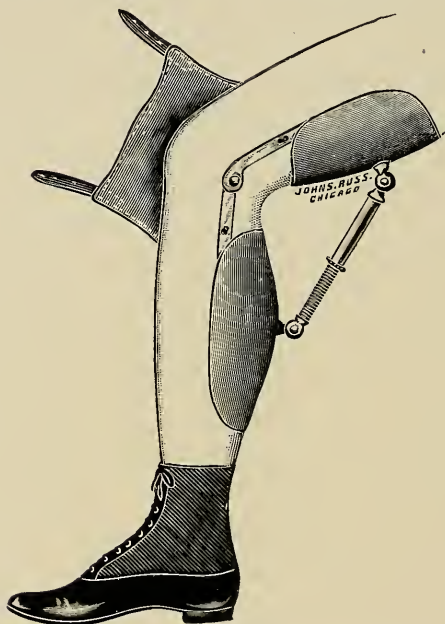
Fig. 133. The author's mechanical apparatus for the knee.

already described, will be found satisfactory in securing the desired end. While in bed a posterior splint can be applied, and ice bags and other antiphlogistic remedies used. After a few weeks in bed with improvement, the treatment is to be carried out as already suggested. If no improvement is made, in a large number of neglected cases, some form of operative treatment will be demanded.

Operative Treatment. Operative treatment may be per-

formed, first, for the removal of degenerate accumulations, so as to assist nature in bringing about a more speedy cure and second, for the removal of the deformity.

The removal of the degenerate accumulations may be effected by injection with or without aspiration, incision and drainage, excision or amputation.

Injection of iodoform emulsion into the joint as described in Sec. IV, Chap. V, has, in the hands of many operators, produced favorable results. With the injections, the usual safeguards are to be used—recumbency, fixation and protection. The injection treatment seems to assist nature to overcome the destructive effects of the bacilli and to stimulate the process of repair.

Aspiration for serous effusion in the knee-joint, if properly performed, rarely gives trouble. An aspirating trochar of medium size may be carried into the anterior part of the joint and the fluid withdrawn. If the fluid is clear, and rest, protection and fixation is secured, improvement will follow. Should re-accumulation take place the operation may be repeated. In some cases it is necessary to aspirate a number of times before the absorbents will take care of the fluids.

Incision and drainage is the proper method of treating cases where pus is found. The incisions are to be made on each side of the joint, and after thoroughly cleansing the cavity with an antiseptic solution, and filling it with iodoform emulsion, drainage tubes or gauze should be inserted into the wounds.

Oftentimes the wound if packed for forty-eight hours, and closed by sutures inserted at the time of the operation, will heal without further trouble. If the suppuration continues, drainage must be kept in the openings and the redressing be frequent until the discharge ceases. Throughout this whole treatment, most rigid rest and fixation must be given to the articulation. Without this adjunct all operative treatment will fail.

At the time of the incision, if a fungus or a pulpy form of degeneration be found, the sharp currette must be used and

all diseased tissues taken away. During the operation, irrigation should be kept up to prevent infection of the surrounding tissue. At each redressing the greatest care must be taken to guard against secondary infection.

Excision of the knee. Where there is evidence of a considerable amount of dead bone, or when there has been a pro-
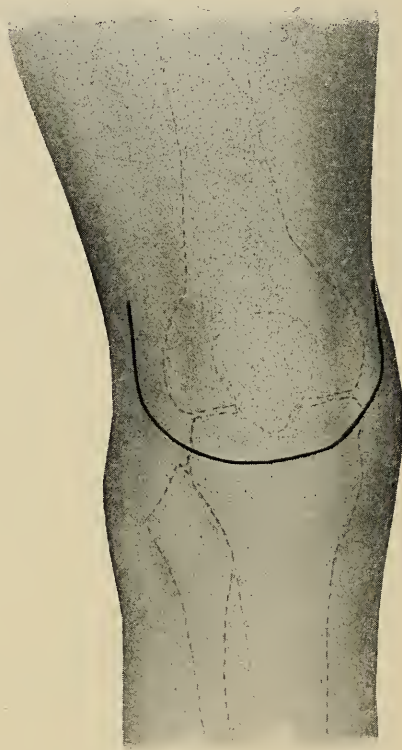
Fig. 133. Curved incision for resection of the knee.

longed suppuration, especially at, or about the age of puberty, and in the majority of adults, excision becomes imperative.

The author uses the horse-shoe shaped flap with its convexity downward, cutting through the ligamentum patellæ. The incision should commence well back upon the sides of the condyles to permit free inspection of the joint and to effect good drainage. The capsule and the ligaments are divided

and the end of the femur cleared so that it can be protruded,
and as much as seems desirable sawed off. In the same way
the head of the tibia is cleared and protruded as a safeguard
against injuring the popliteal vessels.

It is impossible to say how thick a section should be

Fig. 135. Result following resection of the right knee-joint.

remove from the ends of the bones. That must be left to the
judgment of the operator. In some cases after a thin section
is sawed off, the remaining foci may be gouged or scraped out,
thus avoiding the extreme shortening which occurs when large
excisions are made.

The patella is usually removed, the bones brought together, and the line of the limb carefully observed. If care is used in sawing the sections, the leg will be in good position. The cavity is to be thoroughly cleansed of all diseased tissue, and before the flap is brought down and sutured, it is well to

Fig. 136. Attitude of a patient with ankylosis of the knee.

bring the periosteum together and secure it with catgut. Drainage is to be placed in each side, and the whole joint well covered with antiseptic dressing.

The fixation of the incised ends of bones should depend upon an external splint. Apply a snug plaster of Paris bandage from the foot to the groin, and incorporate in it arched iron

rods, so that when redressing is necessary, a section about the wound can be sawed away. The plaster cast may be left in place for a long time, especially if suppuration does not follow.

Some operators remove the drainage and apply the plaster

Fig. 137.   Showing character of deformity in ankylosis.

cast twenty-four hours after the operation. In this way the dressings remain clean for a long time, if the work has been aseptic.

The only precaution that is necessary in the after treatment is not to allow the patient to try to walk on the extremity too soon. Two or three months in which to secure firm bony union should be allowed.

Amputation. The removal of the limb by a thigh amputation is in many cases of extensive knee-joint disease, the wisest procedure. The choice of operative treatment must in all cases be decided by the surgeon, and the probable result explained to the patient or friends. Sometimes a case will

Fig. 138.   Result two weeks after operation for ankylosis
of the knee.   In plaster cast.

need amputation, as a means of getting rid of exhaustive discharges, even after excision. In any cases of doubt an exploratory incision into the joint enables one to decide either upon an excision or an amputation.

Ankylosis of the Knee-joint. The removal of the late de-

formity, or the ankylosis, should only be attempted after all inflammation and sensitiveness from the knee-joint disease has subsided. If it is fibrous, it can be overcome by tenotomy with forcible replacement; if bony, excision of a wedge-shaped piece of the bone should be performed.

Tenotomy for fibrous ankylosis of the knee, is performed on the ham string tendons, and is best done by the subcutaneous method. In some cases, only the outer tendon will need division. If there should be a thickened or cicatricial contraction in the popliteal space, an open dissection should be done.

Manual forcible flexion and extension should then be performed, and the leg brought into line with the thigh, and after the wound is dressed, a plaster of Paris cast should be applied. The after treatment should be carried out as described for knee-joint disease.

Excision for bony ankylosis of the knee, consists in removing a more or less wedge-shaped piece of bone according to the degree of permanent flexion that has taken place. The surgeon's eye will usually decide upon such section as will bring the bones to a degree of slight flexion, rather than that of too great extension. Some caution is necessary not to wound the popliteal vessels while sawing out the wedge-shaped section of bone.

In regard to the fixation of the fragments and the dressings, the same remarks will hold good as in cases of ordinary excisions. The use of Esmarch's bandage will assist in the rapidity of the operation, and its early removal will allow oozing to be checked before the wound is closed.

If the operation is thoroughly and aseptically performed, immediate closure and fixation can be secured.

CHAPTER IV.

ANKLE-JOINT DISEASE.

Definition—Etiology—Pathology—Symptoms—Diagnosis—Differential Diagnosis—Prognosis—Treatment—Protective, Operative, Injection, Excision, Amputation.

Ankle-joint disease is a chronic inflammation of the ankle-joint, the bones and synovial membrane being involved in the form of a chronic osteitis and synovitis.

The affection is called by some writers, *tuberculosis of the ankle,* while others term it chronic synovitis of the ankle-joint.

The disease occurs both in childhood and in adult life.

Etiology and Pathology. Like hip-joint disease, and knee-joint disease this affection may be traced to a sprain, to an acute arthritis, or to an insidious disease coming on very slowly without any apparent cause. As the ankle joint, of all the joints in the body, is the most liable to sprain, it is probable that the greatest number of cases arise from that cause.

Constitutional predisposition unquestionably has very much to do in influencing the course and termination of this affection. The disease may begin as a very simple lesion, and with a tubercular tendency present, it is liable to go on to a destructive tuberculous osteitis or synovitis.

The pathological changes met with in ankle-joint disease, are identical with those of chronic joint disease elsewhere. Osteitis, or tubercular foci, may be present in the lower end of the tibia or fibula, or in the astragalus. The joint cavity and synovial membrane may be affected secondarily or primarily. In many cases, fungus granulations appear, and in some there is the formation of pus and sinuses.

Symptoms. The symptoms show much variation in dif-

ferent cases. As a rule, the cardinal symptoms of chronic joint disease may be recognized at a comparatively early period. They are lameness, deformity, pain, night cries, fever and abscess.

Lameness is an early and marked symptom. It is produced by the sensitiveness which weight-bearing causes in walking, and the muscular stiffness which will not allow the

Fig. 139. Ankle-joint disease.

ankle to bend, as the patient throws the body weight over the ball of the foot.

Deformity is produced by the swelling, the muscular contraction and the atrophy of the tissues above the joint.

The swelling varies in different cases, but is present to some extent in all. It first makes its appearance below and

in front of the malleoli. Later in the affection, it consists of an œdema of the soft parts around the ankle, along with a distention of the joint capsule.

The muscular contraction produces a slight extension and abduction. The foot assumes a position with the toes pointing slightly downward and inward (talipes equino-varus).

Pain is present according to the severity of the case. As a rule, the pain is more acute when the synovial membrane is involved and distended with fluid. In severe cases, any attempt at motion of the joint makes the pain excruciating. In this class of cases night cries may be present.

Heat is sometimes a very pronounced joint symptom, especially in cases that run a rapid course. The ankle joint feels hot and painful to the patient, while to the touch an unnatural degree of heat is present in it.

Abscess results in a great many cases. When it occurs, there is usually considerable suppuration from the soft cellular tissue around the joint as well from the synovial membrane. As a rule when pus forms in the course of the disease, there is so much of the surrounding tissue involved that infection is carried to the adjacent articulations; and, in this way the tarsal bones and their articulations become diseased secondarily, and sinuses form on either side and continue to discharge pus and serum.

Diagnosis. The recognition of ankle-joint disease is dependant upon the symptoms, and the clinical history. Lameness, deformity, pain, and sometimes fever, night cries and abscess, all in their usual form will nearly always establish the diagnosis.

Generally there is sufficient distention of the synovial membrane to allow the fluid to be detected by fluctuation throughout the joint cavity. The points of greatest tenderness are in front of the malleoli. If there are pus sinuses, an examination with the probe will show the presence of denuded bone with the characteristic grating sensation.

Differential Diagnosis. The principal disease conditions that are to be differentiated from ankle-joint disease, are periarticular inflammations and hysterical affections.

Inflammation of the tendon sheaths and cellulitis of the ankle may, in some respects, resemble ankle-joint disease, but they are lacking in the typical joint symptoms.

Hysterical or functional ankle-joint disease often follows a sprain, and some care should be exercised in making the examination in order that the distinction may be made between the nervous symptoms and those which are charac-

Fig. 140.   Periarticular inflammation, sometimes mistaken for
ankle-joint disease.

teristic of joint disease.   Many times a sub-acute inflammation of part of the synovial sac, may persist for a long time after sprain, and if local heat and sensitiveness be found, it indicates the need of treatment, and shows that the affection of the joint is at least not altogether hysterical.

Prognosis. The prognosis in ankle-joint disease is quite similar to joint disease of the hip or knee.   When the disease

is once well established, nature's repairs at the ankle do not seem to be quite as effectual as they are at the knee.

The tendency of the disease to spread to adjacent joints and bones, increases the destructive effects of the morbid process. This is true to such an extent in severe cases, that often the question of amputation is considered in preference to the more conservative plans of treatment.

Children with a mild ankle-joint disease, as a rule, do well under conservative treatment. Many cases recover completely. In adults the disease does not progress so favorably.

Treatment. In ankle-joint disease the general principles of the treatment are similar to those for hip or knee-joint disease. The general treatment is the same, but the local treatment must of course be modified according to the anatomical conditions, and the functions of the joint.

The local conditions call for protection and fixation. A gentle protection against swelling, as well as fixation to prevent any jar or injury, are a comfort to the patient, and do much to relieve an existing inflammation.

Plaster of Paris bandages applied to form a cast from the base of the toes to the knee, and in some cases above the knee, are the most convenient methods of treatment to fulfill the indications for protection and fixation.

Protection can be still further furnished, by having the patient use crutches in moving about, thus giving the ankle absolute rest. The plaster treatment is particularly adaptable in mild cases, and should be applied without padding unless the skin is broken.

As the cast is removed at intervals, the proper attention can be given to motion in the joint, the condition of the skin, and to special joint treatment. The patient should not be allowed to use the plaster cast in walking.

The plaster cast is found to be servicable as a supplementary dressing, following all operations on the ankle, as it furnishes the desired protection and fixation, and is a preventive of the deformity that so often follows.

Operative Treatment. The operative treatment that may

be resorted to in ankle-joint disease, includes injection, incision and drainage, resection and amputation.

The more conservative plans may be tried, but are not to be carried so far as to allow the disease to spread from delay in adopting the more heroic measures.

Injection treatment, combined with protection and fixation will in some cases produce an improved state of affairs, and perhaps be all that is needed to effect a cure. The injections are to be made in front of the tip of the external malleolus, the needle to be pushed between it and the astragalus, into the joint cavity.

Incision and drainage, should always be resorted to where abscesses form. The abscess must be opened and an effort made to trace the discharges to their source. If dead bone be detected it should be removed. The curette may be used to great advantage, as oftentimes the necrosis is limited to a small area and can be easily scraped away.

Following the operation all antiseptic and aseptic precautions are necessary, as well as the proper attention to protection and fixation.

Excision is indicated for ankle-joint disease when in children the disease becomes extensive, or where the osteitis or necrosis involves the tarsal bones.

Children recover from excision of the ankle far better than adults. It may also be said that the cures from ankle-joint disease by excision, are greater in number than after excision of any other joint. (Hodges, Cabot, Bradford, Lovett.)

The excision must be so performed that every particle of diseased bone is removed; for unless this is done thoroughly, relapses are liable to occur. More relapses occur from imperfect operations than from any other cause. The earlier the excision is performed the better the result will be.

If a tarsal bone is involved, the whole bone should be removed. The writer has removed the astragalus in three cases and the astragalus and os calcis in another case, with most excellent results. As many of the tarsal bones should be removed as are involved, and all of them if necessary.

If the malleoli are not involved they should be left intact, but if they are involved, then as much bone is to be cut from one or both of them as is necessary. The weight-bearing function of the leg is better retained by leaving a somewhat broad and even surface, if the lower ends of the leg bones must be removed.

Various methods are advised for excision of the ankle. The preference is for a lateral or curved incision. It

Fig. 141. Showing line of incision for excision of the ankle-joint.

is made along the outer border of, and just below, the external malleolus. The peroneal tendons are dissected out, secured by sutures and then cut by a deeper incision. The capsule can be easily cut by passing the scalpel along the anterior and posterior surfaces of the tibia. The foot can then be dislocated inwards as far as desired, and the joint inspected.

With the foot dislocated, a good view is obtained of the interior of the joint, all the bones being accessible. If necessary, the incision can be carried higher on the leg, or further downward over the tarsal bones.

After the diseased parts have been removed, the foot is

reduced to its proper position, the peroneal tendons united, and the wound closed. The after treatment is similar to the treatment of the other resections spoken of. Aseptic dressing and fixation with a plaster bandage in a correct position is demanded. The foot should be held at right angles with the leg and in the same plane.

Amputation for ankle joint disease may be resorted to where the disease is extensive and the discharges are exhausting. It is often indicated in adults, and may be performed through the lower third of the leg. Generally speaking it should only be considered as a last resort.

JOINT DISEASES OF THE FEET.

Astragalo-Calcaneal Joint—Medio-Tarsal Joint—Scapho-Cuneiform Joint—
Metatarso-Phalangeal Joint — Symptoms — Diagnosis — Prognosis—Treat-
ment.

The joints in the feet are subject to the same morbid con-
ditions as the joints elsewhere in the body. The joint be-
tween the astragalus and os calcis is of considerable size and
is frequently the seat of chronic inflammation. The same
may be said of the medio-tarsal articulation, and in addition,
this joint admits of a considerable degree of motion, making
it more liable to inflammation from sprains.

The scapho-cuniform and the metatarso-phalangeal artic-
ulations should be mentioned in this connection, as some-
times being the seat of chronic joint disease.

The etiological factors are similar to those entering into
the causation of other joint affections. Probably injuries of
some sort give rise to the largest number. The disease may
be very insidious or it may be rapid in its development.

The pathological changes are the same as those of a syno-
vitis and an osteitis. The disease at first may be in either
the synovial membrane or in the bone. In many cases it
goes on to necrosis and suppuration. On account of the bones
being small and cancellous, and because of the close prox-
imity of the joints to one another, the disease may spread
and a number of bones and joints become involved.

Symptoms. The symptoms that are manifested, are
lameness, deformity, pain and sometimes abscesses. They
vary according to the severity of the affection.

In some cases the lameness is extreme, while in others
it does not prevent the patient from walking on the foot.

The deformity is usually that of swelling, and the foot

assumes a form of talipes. The pain is usually present at the seat of the disease, and is increased by any motion of, or pressure on the foot. The pain usually subsides, after an abscess forms and opens externally. If an abscess forms, it will point at the surface near the seat of the disease.

Not infrequently a cellulitis of considerable extent may arise in the foot, and if the suppuration continues long, the connective tissues join in the ulcerative and degenerative process.

Diagnosis. There is usually no difficulty in making the diagnosis. The history of a chronic inflammation, together with the symptoms of lameness, deformity, swelling, pain and sometimes abscesses are sufficient.

The diseases that are at all liable to be mistaken for joint disease of the foot, are chronic neuritis, bursitis, hysterical affections and chronic rheumatism or gout. If it is remembered that in neuritis there is no swelling; in bursitis, the swelling is confined to the bursa; in hysterical affections, there are times when all symptoms of joint disease are absent, and in chronic rheumatism and gout many of the joints throughout the body are similarly affected; little or no trouble will be had in arriving at the true nature of the chronic joint disease.

Prognosis. In children the prospect of saving a useful foot is good under proper treatment, while in adults it usually becomes necessary to remove a portion of the foot by excision or amputation.

Treatment. The early treatment is to make such applications of wet dressings or liniment, as will cause the pain and the active inflammation to subside, and this in connection with absolute rest and elevation of the foot.

If there is no abscess, this treatment may well be followed by the wearing of a plaster of Paris cast on the foot and leg for their protection and fixation. The usual precautions should be observed until all sensitiveness has disappeared, before allowing the patient to exercise on the extremity.

If an abscess is present, the treatment is operative. The removal of the bones that are involved in the necrosis should be practiced, and this followed by fixation and protection by

means of a plaster cast, so as to retain the foot in a useful position.

In all operations upon the foot, precaution should be taken against unnecessary deformity. The writer has treated a number of cases of club-foot that developed following operative treatment for joint diseases of the foot.

The operative treatment should be very thorough in the removal of all diseased tissue. If a portion of a tarsal bone is involved, the whole bone should be removed. Many relapses have occurred by not observing this precaution. In severe suppurative cases, it may be necessary to remove quite a number of bones or even to do an amputation.

SACRO-ILIAC DISEASE.

Definition—Etiology—Pathology—Symptoms—Diagnosis—Prognosis—Treatment—Protective and Operative.

Sacro-iliac disease is chronic inflammation of one or both sacro-iliac joints.

It is also known as *Sacro-Coxitis* and *Sacro-Coxalgia.*

The disease is not common, but it may occur in early adult life.

Etiology. The disease may develop as the result of direct or indirect violence to the joint, secondarily to acute arthritis or from tuberculosis.

Parturition is assigned as a cause (Bradford and Lovett), while Chanvel states that the disease is common in young cavalry soldiers, and thinks that the equestrian exercises may be the exciting cause. Many cases result from direct violence to the pelvis, such as falls and crushing injuries.

Pathology. The sacro-iliac joint is affected by an acute form of inflammation at first, and this usually passes to a chronic state. The lesion then is identical with chronic joint disease elsewhere. The disease may begin as an osteitis, or a synovitis or as both.

Granulation and degeneration of tissue may take place, and an abscess form. The pus may gravitate from the outside of the joint, or from the pelvic side and work its way to the surface. A common place for these abscesses to open is in the groin.

Symptoms. The symptoms of sacro-iliac disease are pain, lameness, deformity, and sometimes abscess.

The pain at first may be variable, but later it becomes constant and more or less severe. It may be in the joint, or

be referred to the bowels or bladder, or along the course of the sciatic or crural nerves. The pain is increased by jarring.

Lameness occurs early, and walking is difficult. If the patient is able to walk, he does it with a careful, gliding and swaying movement.
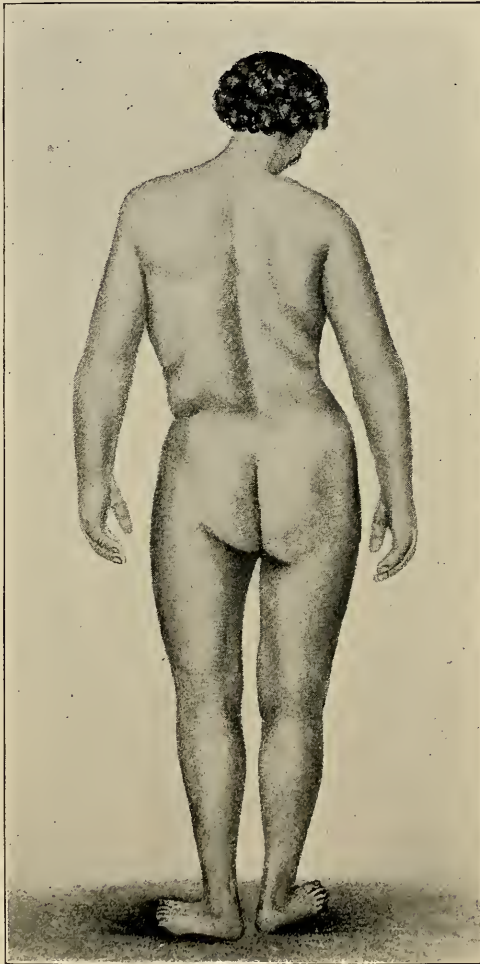
Fig. 142. Attitude in sacro-iliac disease.

Deformity is the result of inclining the body to the sound side while walking or sitting. The pelvis is tilted and the

spine becomes curved. The attitude is considered by Sayer as characteristic.

The elongation of the limb is from the tilted pelvis. Swelling may appear over the joint. The muscles of the buttock gradually become atrophied.

When abscesses occur late in the affection, the pus finds its way to the surface in the direction of the least resistance.

Diagnosis. The diagnosis of sacro-iliac disease can usually be made from the symptoms. Sometimes, however, it is difficult. Pressure over the line of the articulation, posteriorly, will usually show evidence of tenderness. There may be a slight fluctuation present. In some cases, tenderness can be determined by making pressure through the abdominal walls against the anterior portion of the joint.

There are some diseases with which this affection may be confounded. Sciatica, lumbago, lumbar Pott's disease, inflammation of tissues adjacent to the joint, as proctitis and apendicitis, caries of the ilium, hip-joint disease and some other affections have been mistaken for it.

In all these diseases a careful study must be made of the points of tenderness, and this in connection with the other diagnostic features. In sciatica, the tenderness is throughout the course of the sciatic nerve; and it occurs in elderly people. In lumbago, if tenderness is present, it is diffused and is higher in the back.

In lumbar Pott's disease, the tenderness and muscular stiffness is in the lumbar region. Caries of the ilium, inflammation of the psoas muscles and some other lesions are often diagnosed with difficulty, but if the case is watched for some little time, a safe conclusion can be reached from the location of the tenderness.

In hip-joint disease, the muscular stiffness restraining the joint motion generally, can be distinguished from the stiffness of sacro-iliac disease, which is usually only due to the contraction of the psoas and iliacus muscles.

Prognosis. The prognosis in sacro-iliac disease may be said to be unfavorable in advanced cases. There seems to be a strong tendency toward chronicity with a destruction of

the joint, and necrosis in this affection. In many cases, there is extensive suppuration until the patient finally dies from complications and exhaustion.

Of late years, the results obtained by treatment would indicate that a much larger percentage of cures have followed operations than formerly. This is probably due to the improved methods of operating and to asepsis.

Treatment. The early treatment of sacro-iliac disease should be carried out by keeping the patient in bed with the limb extended. Extension by weight and pulley may be employed if necessary to keep the body and extremity in a straight position. Immobilization of the pelvis may be produced by means of plaster of Paris, or by the application of adhesive plaster drawn tightly around the body. A few months of the recumbent treatment will often cause a subsidence of the inflammation, so that the patient can be allowed to move about in the open air with the assistance of crutches.

Protection against motion at the joint and weight-bearing, should be continued until all sensitiveness has disappeared. The progress can be determined at various times by the test of making pressure on the joint.

Where pain is severe, it can usually be relieved by making application of heat or counter irritation over the joint, in connection with the recumbent treatment.

Operative Treatment. Where abscess forms, operative treatment should be resorted to. If the abscess is posterior, an incision should be made over the joint and the pus and necrotic bone thoroughly cleaned away. The currette is to be used in an effectual manner, followed by irrigation and the packing of the wound with iodoform gauze.

If the abscess is anterior, or inter-pelvic, the disease may be reached by the extensive removal of the healthy bone after the methods of Tiling and Van Hook.

The bone is laid bare near the posterior part of the crest of the ilium of the affected side. It is then chiseled through, so that the anterior surface of the joint is reached, and with a curved curette all the diseased tissue is scraped away. The cavity is drained, redressing and protection used and the recumbent treatment enjoined until recovery takes place.

CHAPTER VII.

JOINT DISEASES OF THE UPPER EXTREMITIES.

Shoulder-Joint Disease—Elbow-Joint Disease—Wrist-Joint Disease—Etiology, Symptoms, Treatment—Protective, Operative.

SHOULDER-JOINT DISEASE.

Shoulder-joint disease, signifies a chronic inflammation involving the synovial membrane and the bone. The affection is somewhat more rare than acute inflammatory shoulder-joint diseases. The disease is usually found in young persons.

Etiology and Pathology. Shoulder-joint disease can usually be traced to some injury, such as a fall upon the joint or a sprain. Sometimes it is preceded by an acute arthritis. The disease is usually preceded by an acute inflammation. It rarely develops, from the beginning, as an insidious tubercular affection.

The head of the humerus is the portion of the joint that becomes first involved, the glenoid cavity and the coracoid process becoming invaded later. The process of development of the disease, does not differ from that as described under joint disease elsewhere. There is one feature, however, differing from those already described. The function of the upper extremity not being that of weight-bearing, the disease is not aggravated by it as in the case of the lower extremities.

Symptoms. The symptoms that become marked are joint stiffness, pain, atrophy of the muscles, and sometimes swelling and abscess.

The stiffness and soreness at the joint is a very early symptom. It prevents a free arc of movement, especially when the elbow is thrown well outward from the body. The extremity hangs weak and more or less helpless at the side.

It will be found, on careful observation, that quite a degree of motion is allowed the arm by the movements of the scapula.

Pain is a symptom of varying severity. It usually follows the stiffness closely and is of a dull aching character. The patient may locate the pain in the joint, or it may be referred to the middle of the arm, near the insertion of the deltoid.

Generally the patient feels worse at night. He fails to get the shoulder in a comfortable position to allow him to sleep. Tenderness will usually be found over the capsule around the head of the humerus.

Atrophy of the muscles occurs early, and produces quite a change in the contour of the joint. The bony prominences stand out much more plainly than they do on the opposite side. The shoulder usually droops somewhat lower than the opposite one, but if measurements are taken, the head of the humerus will be found to be in the glenoid cavity.

Swelling, if it occurs, is due to the distention of the capsule with fluid. The humero-pectoral groove and the depression below the acromion becomes shallow and indistinct. In looking down upon the shoulder from above, it appears broader than normal. The position of the arm is that of slight abduction. There may be a bulging of the capsule in front and behind the joint, and fluctuation may be distinctly felt through the cavity.

If abscess forms, the disease becomes more painful as the swelling increases. The pus may find its way to the surface by traversing through tissue that offers the least resistance, and point in the axilla at the border of the deltoid, in front of or behind the joint.

Diagnosis. The diagnosis is a simple matter, when the symptoms are borne in mind. Other affections, such as bursitis and chronic rheumatism, should not be mistaken for shoulder-joint disease. In bursitis some of the movements of the joint can be made without resistance. Chronic rheumatism is multi-articular, and an affection of advanced life.

Prognosis. Shoulder-joint disease so often occurs in the form of a mild osteitis and synovitis, that we may say that the prognosis is favorable. If suppuration occurs, the prognosis

becomes much more unfavorable. It means a protracted discharge of pus and spiculæ, with destruction of the head of the humerus.

A cure may result by ankylosis in time. Under proper treatment the results are better.

Treatment. The indications for treatment in shoulder-
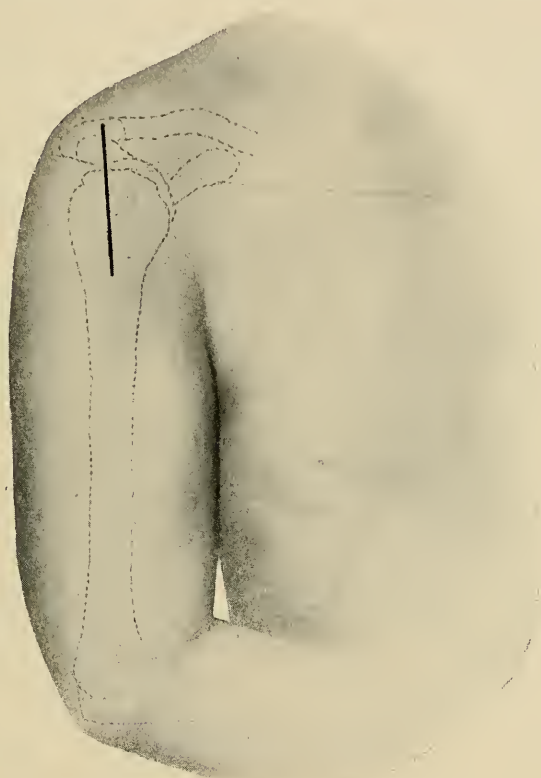
Fig. 143. Showing line of incision in excision for
shoulder-joint disease.

joint disease is usually that of rest and protection, until the inflammation has subsided, and then gentle exercise until the joint function is re-established.

Protection and rest is best secured by the ordinary Velpeau dressing. It should be removed and gentle motion made at the joint, and be reapplied at least once a week. As the

patient improves, in time no dressing need be used. The natural traction made by the weight of the extremity and passive movements being beneficial.

Violent exercise of the joint should not be indulged in, until all sensitiveness and muscular stiffness has disappeared. The application of medicine or electricity is serviceable.

Excision of the Shoulder-joint. In cases of shoulder-joint disease where abscess has formed, it is well to perform excision, especially if the discharge of pus and sequestra has taken place for a long time.

From a study of the records of suppurating shoulder-joint disease, it is found that better results follow excision than any other operation. Partial operations, such as drainage with curetting the dead bone through incision, do not yield good results. A stiff shoulder-joint is to be avoided. As ankylosis usually follows the more conservative operative methods, the method of excision and a free moving joint, is to be preferred. The shortening that follows excision is no great impediment to the usefulness of the extremity.

The incision for excision should begin at the anterior border of the acromion, close to its articulation with the clavicle, thence running vertically downward from two to four inches, it divides the deltoid muscle and reaches the capsule of the joint and the periosteum of the humerus.

The tissues are retracted and the periosteum and muscular attachments are separated from the bone by rotating the arm outward and inward. A chain saw can be passed around the bone and a section made, as seems necessary, to remove the diseased bone.

The head of the humerus is then dislodged and all other diseased tissues cleared away. The wound is to be treated as in other resections, with sutures, drainage and absorbent dressings. Fixation of the arm can be obtained by bandaging it to the side with a thick pad between the body and the inner side of the arm.

Plaster of Paris bandages applied around the arm and chest affords the best fixation. After a time, it is well to use

simply a sling for the forearm, as complete fixation will be unnecessary.

To secure free motion at the joint, passive movements should be commenced as soon as possible after the operation. The movements need only be limited until all sensitiveness has disappeared, as then the ordinary exercising by the patient will develop a sufficient motion for usefulness.

ELBOW-JOINT DISEASE.

Chronic disease of the elbow-joint may occur similar to that which develops in other joints. It is subject to the same influences as structures of like character in other parts of the body. It is especially liable to injuries from sprains and bruises, and is frequently the seat of acute inflammations from these causes. An osteitis frequently follows, or in some cases it appears with no history of injury.

This joint is often the site of an acute arthritis or synovitis, which may continue several weeks or months and then subside entirely, or the function of the joint may be impaired, and then, by subsequent injury, the chronic disease is established.

Symptoms, When the the lesion becomes well developed, it presents the same symptoms as other joint diseases. Stiffness, pain, atrophy of the muscles, swelling and sometimes abscess are present,

The stiffness is that of a limitation of flexion and extension of the forearm, and is proportionate to the extent of the disease.

The pain may be a conspicuous symptom from the beginning, or it may only be present at times. In some cases it is absent, excepting when an attempt is made to move the joint.

Atrophy of the muscles takes place above and below the joint. When the disease is well established, this is a marked symptom. By it alone the joint appears very prominent.

Swelling is always present to some extent, and in some cases it is extreme. It takes place all around the joint.

Where the synovial membrane is distended it appears to bulge out between the bony prominences—olecranon and condyles —and fluctuation can be detected through the joint cavity.

If the disease progresses, all the above symptoms increase and are accompanied by heat in the joint and general constitutional disturbance.

An abscess forms with numerous sinuses in the severe cases, and the degenerative mass furnishes soil for tubercular and other infection. The soft parts become involved

Fig. 144.   Elbow-joint disease.

and the whole arm becomes a pulpy, inflamed and a suppurating mass.

Treatment. The treatment of elbow-joint disease is often discouraging. This is probably due to the fact that in mild cases the disease is protracted, and during much of the time there is freedom from pain and sensitiveness, and there is a tendency to use the joint, which is to some extent accountable for relapses.

If the symptoms are at all severe, the use of wet boric acid

dressings should be employed until the swelling subsides, during which time the joint should be kept at rest by the use of a well adjusted sling. This can then be replaced by a more permanent dressing of plaster of Paris.

Where there are no superficial signs of inflammation, the plaster bandage furnishes the most convenient mode of fixation and protection and should be constantly used until a cure is effected.

It is always well to keep the elbow flexed at nearly a right angle, for if ankylosis occurs with the forearm extended, the usefulness of the extremity is impaired. In these cases there is a great tendency toward ankylosis, and it is well not to strive
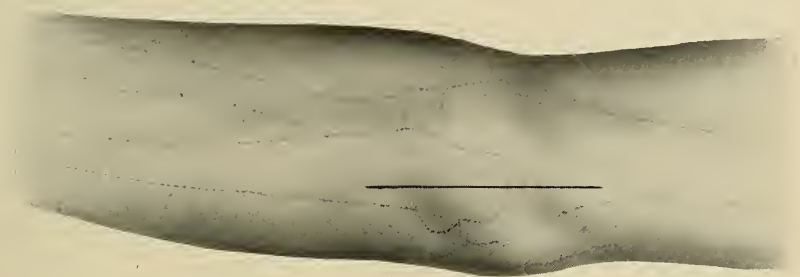
Fig. 145. Showing line of incision in excision for elbow-joint disease.

too much against it, as the injury done by motion to prevent the ankylosis, might result in the loss of the extremity. An elbow ankylosed in the angular position affords quite a useful extremity.

Excision of the Elbow-joint. In elbow-joint disease, if after the more conservative methods of treatment, the disease is found to be progressing toward suppuration, excision is indicated. It is always well to resort to excision early, before amputation becomes the only measure holding out any prospect of relief.

This operation is also indicated in some cases to correct a faulty position with ankylosis.

The incision generally used is that advocated by Lan-

genbeck. The incision is made three or four inches long, longitudinally, a little to the inner side of the median line of the tendon of the triceps and is carried down to the bone

Fig. 146. Showing operation of excision of the elbow.

throughout its entire length. The periosteum and muscular attachments are raised, and the dissection is continued close to the bone toward the condyles. Care is taken to preserve all structures not involved in the disease.

The lower end of the humerus can then be dislocated through the wound, and sawed off at whatever point seems to be necessary. The ulna and head of the radius can be cleared and sawed off with the chain saw, or sometimes the bone forceps is used.

In some suppurative cases, where pus sinuses exist, the surgeon may make use of any incision that may best allow space, to reach and remove the diseased tissue. The direction of the incision may be suggested by the location of the sinuses or the abscess cavity.

Free drainage, and dressings with fixation are to be used in the same manner as after excision elsewhere. If a considerable portion of bone has been removed, and the bones are not in apposition, it is better to make a movable joint, following the excision, than to permit ankylosis. In the majority of cases ankylosis is aimed at as the best possible result, so that passive movements need not be considered. This, however, will depend upon the judgment of the surgeon. A limited amount of motion following excision at the elbow is of great advantage to the patient.

Diseases of the Wrist-Joint.

Disease of the wrist implies a chronic inflammation of any or all the articulations that enter into the formation of the wrist-joint. It is usually an osteitis and a synovitis combined, which involves a number of the carpal bones with the adjoining synovial membrane.

The disease most often follows a sprain, or perhaps a succession of sprains. It develops very slowly and extends over a long period of time. Like disease of the tarsus, it often suffers a tubercular infection and continues as a destructive tuberculosis.

Symptoms. Clinically, a case of wrist disease presents a picture with symptoms quite similar to other joint diseases.

In this affection, the most prominent of the cardinal joint symptoms is the swelling. The enlargement about the wrist is characteristic. It takes place all around the wrist, extend-

ing from the lower end of the radius to about the middle of the metacarpal bones, and is more extensive antero-posteriorly, than it is laterally.

A slight flexion at the wrist is present, and any attempt at motion causes pain. There is the accompanying atrophy of the tissues above and below, and the patient loses all muscular control of the fingers.

In severe cases, suppuration and necrosis may occur. A redness of the surface and an extension of the swelling to the forearm above, or the fingers below, indicates the formation of pus.

Fig. 147. Disease of the wrist-joint.

Treatment. In diseases of the wrist, fixation is strongly indicated and can be accomplished by common splints and by carrying the forearm and hand in a sling. The best method of fixation is the use of the plaster of Paris bandage applied snugly to the skin. It forms a permanent dressing and is very comfortable to the patient.

The writer has had excellent results in slow and obstinate cases, by the injection of iodoform emulsion deeply into the tissues in a number of places around the joint. The treatment was followed by the application of plaster dressing for ten days and then repeated. Three or four treatments have caused the swelling to disappear and the disease to abate. Protection and fixation must be followed for many months to prevent a return of the disease and to effect a cure.

Excision of the Wrist. Excision of the wrist is indicated

in suppurative cases, or in those that resist the more conserv-
ative methods of treatment.

A variety of methods of excision have been advised, but
generally the nature of the case will suggest to the surgeon
where to make the incision and how best to proceed.

Many operators prefer the long single dorsal incision. It
should begin at the center of the ulnar border of the first
metacarpal bone, and should be carried upward to the middle
of the dorsal surface of the epiphysis of the radius, and dis-

Fig. 148.   Showing line of incision for excision of
the wrist-joint.

sected down to the bone. The tendons are lifted with the
periostium and carried to the inner side. The hand is then
flexed and the articular surface of the carpal bones exposed.
The ends of the radius and ulna, may be denuded and pushed
through the wound and sawed off in the usual manner.

It is always well to vary the operation according to the
location of the abscess and the necrosis. As a rule, however,
the free removal of the carpal bones, with the articular ends
of the bones above and below, will yield the best results.
Some cases seem to continue to suppurate and involve adjoin-
ing structures, even after excision, until finally an amputa-
tion is performed to relieve the suffering. As in disease of

the ankle, if a carpal bone is diseased in part, it should be wholly removed.

If, however, the operation of excision is properly done, a reasonably good result may be expected. The extremity is considerably shortened, but the fingers and thumb usually regain their muscular power. Some are able to write or work at a trade, and in exceptional cases the hand becomes as useful as it was before the manifestation of the disease.

The after treatment is easily carried out. Rest, fixation and protection are to be continued until the sensitiveness disappears, and then followed by gentle movements and manipulations.

SECTION VI.

RICKETS—PARALYSIS.

BY

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CHAPTER I.

RICKETS.

Definition — Etiology — Pathology — Symptoms — Complications — Diagnosis— Prognosis—Treatment—Prophylactic and Curative.

Definition, Rickets is a general disease of infancy and early childhood, and it is sometimes evident at birth. In it, the nutrition of all the tissues of the body is affected and their growth and development arrested. Ossification is delayed and perverted, and dentition is retarded. The bones not having solidified, yield to pressure and muscular action. The muscles and ligaments are relaxed and wasted, important organs such as the brain, liver, spleen and lymphatic glands become altered, and the alimentary canal becomes weak in the performance of its functions. It is also known as *rachitis* and *rhachitis*.

Etiology, Rickets is produced by slow impairment of nutrition. The causes may begin to act during intra-uterine life from the period of conception. They more generally begin to act after birth, and are the result of the conditions in which the child is born. When the latter are continuous with the former, the debasement of the tissues and the lessening of the vitality become greatly marked.

It is a disease of mal-assimilation in which there is a primal degradation of cell structures, from weak cell vitality, or deficient elements for cell building, the causes being widely different. While existing chiefly among the poor, occupying localities and under conditions in which the absence of sunlight, unsanitary surroundings, and deficiency of proper food are conspicuous, it often appears among the wealthy and fashionable.

Women raised in luxury are often weak from inac-

tivity and seclusion, or the demands of fashionable society often break them down prematurely. When such women are about to become mothers, they cannot supply what a growing fœtus demands, nor can they, after the birth of their children, during lactation, supply them with milk that is rich enough in the elements necessary for the proper formation of many of the tissues. Often the demands of fashion compel them to refuse to nurse their children, or they may fail to have any or enough of the lacteal fluid. In such cases, resort is had to artificial food, either entirely or partially. This results frequently in a puny physical development from the disturbance of the digestive and assimilative functions, and an inadequate supply of nutritious elements, especially of the osseous system.

Among the poor, particularly, the cause of rickets in children can be traced to their mothers and to their environments. Insufficient and improper food, cold, damp rooms, want of sunlight, and lack of cleanliness are the efficient causes. They prevail in American cities among foreigners and the colored people, who are huddled together in small rooms in barrack-like quarters, into which the sun never enters, and where there is no provision for cleanliness and ventilation.

Feeble children born into those conditions and fed with artificial food become poorly nourished. Such foods are mostly farinaceous and soon derange the digestive organs. There is in them an absence of the fats, lime salts, and proteids that are the essential elements of human milk, that so well adapts it to the nourishment of the infant. The absence of sunlight and fresh, well oxygenated air, completes the work, and puny, rachitic and deformed children are the result.

Pathology. There is a relative absence of the calcium salts in the osseous frame work. The growth of bone is retarded, the extension of ossification is irregular, and bone already ossified becomes softened. Osteoid tissue persists, and overgrowth of vascular tissue at the epiphyses and in the periosteum and endosteum creates a proliferation of the cartilagenous and fibrous elements, in excess of calcification at these centers of growth. As a result, the line of regular calci-

fication is not maintained, and ossific substances and cartilage, or bone and osteoid tissue become irregularly intermingled, thus forming a soft and weakened structure.

The long bones become too weak to support the body, or resist muscular action. They may even become soft enough to be cut with a knife, or they may become irregularly thickened. A great thickening of the flat bones occurs from the same cause. This is especially noticeable at the edges of the cranial bones, and where ossification becomes complete in these bones there is a ridge of thickening along the lines of the sutures. In other parts of the cranium the bones become thinned by absorption, and by pressure of the growing brain. This condition can be detected by palpation, and is known as *craniotabes*. The fontanelles remain open late, even to the third year, owing to the slowness of ossification in the cranial bones.

The liver, spleen, lymphatic glands and kidneys are enlarged. This is produced by an irregular hypertrophy of the fibroid and epithelial elements of these organs, with deficiency of earthy salts.

The enlargement of the brain comes from an increase in the neuroglia, and not of the nerve elements.

The voluntary muscles are small, soft, flabby and pale, and their striæ are indistinct under the microscope.

The urine contains less urea and uric-acid than normal, and an excess of the phosphates.

When the disease has run its course, rapid and excessive calcification may occur, and sclerosed bone may be formed.

Symptoms. Usually derangement of the digestive functions precedes the onset of the disease. The bowels of the child become relaxed, with loose pasty and offensive discharges, and there is occasional vomiting.

In the beginning of the disease the child prespires profusely about the face, head, and neck, whenever it sleeps, either day or night. He will throw off the bed-clothes and lie uncovered, even in the coldest weather. Later on, he seems to dread movement of any kind; he is evidently tender; dislikes to be touched and cries whenever he is danced about. With the disturbance of digestion, the abdomen becomes pro-

tuberant from relaxation of its walls, and enlargement of the
liver, spleen, etc., occurs. At times the child will be found
asleep upon its face, resting upon its arms and legs which
are drawn up to relieve abdominal discomfort.

Eruption of the teeth is delayed beyond the usual period,
and when they do appear they are often imperfectly covered
with enamel, and subject to early decay.

FIG. 149. Children suffering from rickets—walking delayed until
nearly three years old.

The osseous system as a whole is affected by the diseased
condition, and many and serious deformities result. If the
child has begun to walk, he becomes unsteady on his legs, the
bones begin to bend, or he loses the power of walking alto-
gether. He sits or lies about and is restless and uneasy, is
drowsy by day and at night moves his head from side to side
while sleeping, so that he wears the hair off the occiput.

Chronic hydrocephalus may occur from distension of the ventricles of the brain with fluid, with arrest of ossification of the cranial bones and sutures, with the fontanelles wide open. In other cases, the skull is elongated from before backward, with fontanelles open and sutures thickened. The head generally looks large, with the forehead high, large, square and prominent. Enlargements like nodes may appear on the cranial bones from irregular ossification under the pericranium.

The face seems small and out of proportion to the head, because of arrest of growth of the facial bones.

The spine is curved as the result of weakness of muscles and ligaments. It is usually *lordosis* or *kyphosis*, an exaggeration of the normal curves, and may be so great that the normal posterior curvature may become angular from the unequal pressure upon the borders of the softened vertebral bodies or unossified epiphyses. Lateral curvature—*scoliosis*, may also occur from similar causes. The weight of the head and shoulders produces the pressure which the muscles and ligaments are too weak to resist. There are usually compensatory curves in other regions of the spine.

The chest presents deformities which have marked characteristics. There is a conspicuous groove along the outer border of the sternum, extending from its upper end downwards and outwards. A row of nodules, known as the *rachitic rosary*, is seen and felt along the outer borders of those grooves. Those are the enlarged ends of the ribs. In inspiration the softened and weakened ribs are unable to resist the pressure of the external air, and with their cartilages they are bent inwards, so that the chest is flattened laterally. The sternum is projected forwards, and often bent, increasing the anteroposterior diameter of the thorax and producing the *pigeon-breast* deformity. In a healthy person, the pressure of the external air in inspiration is overcome by the resistance of the thoracic walls and force of the inspired air; in the rickety child, the ribs bend where least supported, and owing to this its breathing is quick and laborious.

A deformed pelvis may also result from the unresisting

bones of the pelvic ring being pressed upon from above by the
spine and abdominal contents, and from below by the heads
of the thigh bones. The direction of the force depends upon
the usual position of the child. The general shape produced
is triangular. The pelvic cavity is greatly narrowed, and its
diameters lessened to an abnormal degree. It causes an
increased projection of the promontory of the sacrum, and a
change in the sacro-vertebral angle.

The deformities give rise to serious obstacles to natural
labor, in women in whom those changes take place in infancy,

Fig. 150.   Showing the epiphyseal enlargement above the wrist.

and are the most frequent causes of major obstetrical opera-
tions.

The upper extremities do not become as much deformed as
do the lower extremities. The enlargement of the bone ends
at the joints, and looseness of the joints are prominent signs
of rickets in children. This enlargement is the result of ex-
cessive vascular and cartilaginous proliferation at the epiphy-
seal junction. When subsequent rapid ossification occurs,
as recovery takes place, it contracts somewhat, but remains
more or less permanent. Arrest of ossification at the epiphy-
ses may produce stunted growth and dwarfish size.

Changes in periosteal ossification may give rise to enlargements, or to softening so that the humerus may be bent by the weight of the limb and by the action of the deltoid muscle in elevating the arm.

Fractures of rachitic bones occur from the usual causes of fracture, and their healing becomes delayed and irregular.

The lower extremities are more liable to deformities through rickets than the upper. The character depends upon whether the child had commenced to walk before the disease began, and upon the rapidity of progress and the duration of the disease. If he had not begun to walk, his weak muscles and bones and lack of vitality would prevent his attempting it, and thus the bones would not be bent. If he was already walking when the disease began, bending would be likely to occur, and the direction would correspond to the forces acting upon the bones. These forces are the weight of the body and the muscular action, modified by the natural direction and curvings of the bones. The deformities thus produced are curvatures of the shafts of the bones in different directions; deformities at the knee-joints as knock-knee and bow-legs. Bending of the neck of the femur and clubbing at the ends of the bones, especially those of the forearm may also occur.

Rickets may be one of the causes producing flat-foot, and some of the forms of club-foot, but in those deformities the chief cause is paralysis.

Complications. A special complication of rickets in children is an extreme nervous impressibility, which renders them liable to attacks of laryngismus-stridulus and convulsions. This sensitiveness of the nervous system is peculiar to rickets, and produces convulsive movements and carpopedal contraction from the slightest causes. In ordinary cases of mal-nutrition with wasting, the natural sensitiveness of the nervous system to external impressions is impaired.

A sensitiveness to cold also exists, which subjects the child to catarrhal conditions of the chest or abdomen, as the result of the frequent chills. When it is pulmonary, it may cause collapse of the lungs on account of the increased difficulty of respiration produced by softening of the ribs. When

it is intestinal, unless quickly arrested, it may cause such a drain as to dangerously impair the vitality of the child. The increased mortality in rickety children results largely from these complications.

Diagnosis. It is very necessary to recognize the existence of rickets early in the life of the child. He need not be thin, but may be somewhat plump. If he begins to lose flesh; has constantly, looseness of bowels with tumid abdomen and occasional vomiting; if he has sweating of the head and neck at night with moving of his head about in sleep; if he tosses off his bed-clothes even when the weather is cold, and if after the ninth month no tooth has appeared and there are enlargements at the wrists, the diagnosis of rickets may be quite positively made. The causes producing it in the particular case should be investigated, and the proper treatment to arrest the disease and to create a healthy development should be begun.

When the disease develops later, the deformities of bones especially at the joints, occurring in different parts of the body, with weakness of limbs indicate the presence of rickets as the cause. Weakness of the legs from rickets can be diagnosed from that produced by essential paralysis, by the child's being able to move his limbs in the former disease. He is not able to stand because the bones are soft, the ligaments relaxed and the muscles weak though not powerless.

Prognosis. The prognosis of rickets is generally favorable. The disease is self-limited and usually terminates by the third or fourth year, or sooner, if the conditions which favored its development are changed, and those which improve the power of the system, including better hygienic conditions, are substituted.

When improvement begins, the symptoms gradually become less intense until recovery is complete. The enlargement at the joints diminish and the bones become stronger and larger, and their distortions are not so marked. The growth of the body, however, is often stunted so that he does not reach the average height.

When the causes continue operating in all their intensity,

and there is especially a lack of important nutritive qualities of the food, the prognosis is unfavorable, and a fatal termination may occur during the progress of the disease, or as the result of a special complication. An attack of catarrhal bronchitis in a rachitic child debilitated by the disease, with softening of the ribs and deformity of the chest, may quickly terminate its life by asphyxia.

In any case, in estimating the chances of recovery, attention must be paid to the presence or absence of disease of the glandular system, and to the amount of chest distortion. If the ribs are softened and the lower ones greatly drawn in on inspiration, a slight pulmonary attack may change a favorable case to one of great gravity.

Treatment. The prophylactic treatment of rickets consists of the use, by the prospective mother, of such measures as will give her vigorous life, and the use by her of such food as will supply to the growing foetus, all the materials that are necessary for complete tissue formation. Plenty of out-door air, and moderate exercise tend to invigorate. In the case of the poor, where they cannot exchange their pent-up rooms for better ones, it is necessary that they should be in the open air as much as possible, and that they take care to frequently ventilate the rooms they occupy. Foul air breathed many times poison the blood. Sufficient bathing of the body, with friction of the skin to keep up its proper activity, must be regularly done. Clothing adapted to the season must be worn so as not to allow any chilling of the surface or possibility of being overheated.

The food taken should be of the most nutritious character possible. One or more times daily a porridge made of oatmeal or flour, made of the entire wheat grain, with cream, will be nutritive as well as regulating to the system. Bread made of whole wheat flour furnishes a much larger proportion of lime salts for nutrition of the hard tissues, than that made of the white flour in common use.

The prophylactic treatment as applied to the child, consists of the use by the mother, during the period of lactation, of such food as will supply to the breast milk all the ingred-

ients necessary for proper development of all the organs and tissues of the child. A healthy mother should be able to supply a sufficient quantity of this, the best of infant food. Up to the seventh or eighth month of infant life it will thrive best on such food.

All mothers, however, are not equally strong, and lactation exhausts some. They become thin and weak, and their milk becomes watery and loses the essential elements of nutrition. Other mothers are not capable of producing sufficient milk, and sometimes for various reasons, the child is deprived of breast milk. In these latter cases substitutes have to be provided, and they should correspond as nearly as possible with the composition of breast-milk. For the first three months, there is but little development of the salivary glands and pancreas, and no starchy substance can be digested. Hence, during that period, farinaceous foods should be withheld, and not until the seventh or eighth month, when the teeth begin to appear, should much be allowed.

A wet nurse, a multipara, whose babe is about three months old, is the best substitute when a mother cannot nurse her child. Care should be taken in her selection, that she is not diseased and has no bad habits.

The chief substitute, however, for the mother's milk is cow's milk, although asses or goat's milk can be used when they can be obtained. There is proportionately a larger amount of albuminoids and less of fat and sugar in cow's milk than in human milk, and often the acid fluid of the infant's stomach coagulates the casein into a firm clot, instead of breaking it up into fine flakes for easy digestion. Unless this is prevented, the alimentary canal becomes so disturbed by diarrhœal conditions that nutrition is permanently deranged. Lime water added to the milk, or later, the addition of the " malted infant foods," acts as a preventive of this firm coagulation, and the fermentative disturbance that it produces.

It has been demonstrated by experiments upon young animals, that rickets can be produced by depriving them of animal fats and the earthy salts, particularly calcium phos-

phates. A chief cause of the prevalence of rickets among children of the poorer classes is that they are fed almost entirely on farinaceous foods, and the mothers depend too much on them. It sometimes occurs that prolonged suckling of infants, for economical reasons, develops rickets. In those cases, immediate weaning of the child, and in all cases, a complete change in the quality of the food, results in a quickly perceptible improvement in the condition of the child.

In all artificial foods a sufficient quantity of fats and proteids should be introduced into the diet of young children in the early months, to make it equal to the mother's milk, and later, they should be so proportioned with the farinaceous substances, as not to disturb the digestive functions, and yet meet the demands for nutrition. When milk alone is given it must contain the full proportion of cream, and in some cases cream may be added in excess. Raw meat juices are especially useful in rickets, and later, raw meat pulp is of great benefit. Cod-liver oil made into an emulsion by shaking it up with lime-water, and some syrup, is sometimes very useful as a nutrient. When the child is older, sandwiches of raw meat pulp, or eggs beaten up with milk or lightly boiled may be given, and the bread should be of flour made from the entire wheat. A firm piece of meat that has been baked or broiled, held in the child's hand to be bitten or sucked during the period of teething, is useful. Sometimes the juice of ripe fruits or fruit jellies may be added to the dietary with benefit. All food should be made palatable and presented in such a form that the child will take it, in order to get the best results.

Rickety children should be kept perfectly clean by the free use of soap and water and gentle friction of the surface. They should be warmly clothed. A band of thin flannel worn around the body preserves an equable temperature to those important regions containing the organs of digestion and respiration. Such children should be taken out daily into the air and sunshine. Their living rooms should be thoroughly ventilated, and should, if possible, be so located that the sun light will shine into them at some period of the day. They

should not be exposed to be chilled, for fear of lung complications.

Derangements of the stomach and bowels may be corrected by a small dose of castor oil, or rhubarb and soda, to clear out the fermenting substances. This can be followed by one or two drops of camphorated tincture of opium in aromatic water, and bismuth, to restrain the operations. The best restorative is proper food, and to that end the digestive functions should be carefully watched, and any disturbance of them at once corrected. As a general tonic, the lacto-phosphate of lime, with a proper proportion of Fowler's soluton of arsenic, or the citrate of iron, taken two or three times a day will sometimes be found to give excellent results.

CHAPTER II.

DEFORMITIES PRODUCED BY RICKETS.

Bow-Legs—Definition, Etiology, Symptoms, Diagnosis, Prognosis, Treatment—
Expectant, Mechanical, Operative; Knock-knee—Definition, Symptoms,
Diagnosis, Prognosis, Treatment.

The most common deformities produced by rickets are
bow-legs, anterior bow-legs and knock-knee.

Bow-legs—*genu varum* or *genu extrorsum*, consists of
an outward curving of the lower extremities, so that, in ex-
treme cases, an oval space exists between them when the feet
are placed beside each other, the distance from each being
greatest opposite the knees. The femur may be bent at its
lower part, or the tibia at its upper part, or both bones may
be curved. The center of the curve may be at the joint,
with relaxation of the external lateral ligament, elongation
of the external condyle of the femur, and a degree of atrophy
of the internal condyle. Where one bone alone is affected,
the shape of the curve is somewhat irregular.

Anterior bow-legs is an anterior bending of the tibia and
fibula at the junction of the lower with the middle third of the
leg. It may occur at the upper third.

Etiology. Bow-legs occurs in young children, beginning
between the first and fourth years of age, as the result of
rachitic softening of the bones. Very rarely, it occurs in old
people, as the result of *osteitis deformans*. When children are
backward about learning to walk, their mothers stand them
upon their feet to induce them to take steps. The weak bones
yield to the weight of the body, inward or outward, according
to the inclination given to the limbs by the position of the feet.
The feet are generally placed naturally together, which pro-
duces the bending outward, and thus bow-legs is more com-
mon than knock-knee. The greater pressure at the knee-

joint is thus thrown upon the inner condyle of the femur, especially if the external lateral ligament is relaxed. The condyle becomes absorbed and atrophied, while the external condyle released from equable pressure, elongates from increased activity of growth in the epiphyseal cartilage.

Symptoms. By placing the child upon its back with
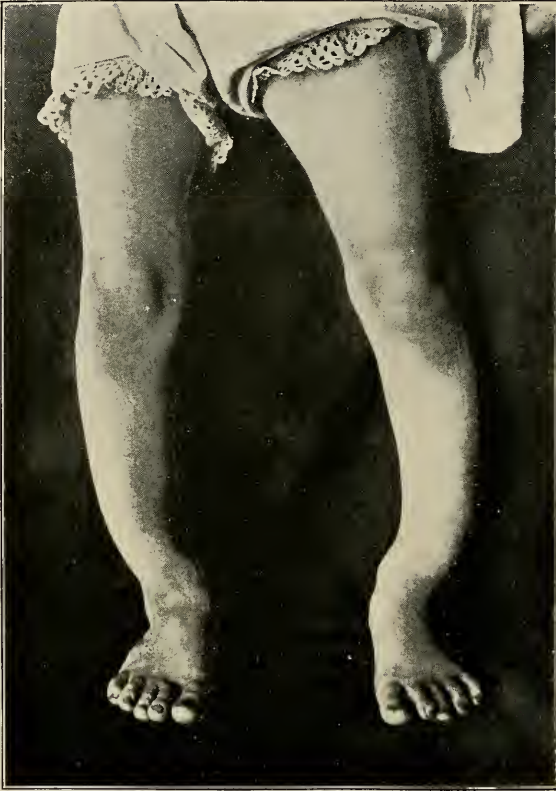
Fig. 151. Bow-legs, affecting principally the leg bones.

thighs and knees together, if the curve is below the knee-joint the legs will cross each other, and the thighs lie together, showing the bend to be below the knees. If the bend is above the joint the more or less oval shaped space between the thighs will indicate the location of the curve.

Children with bow-legs, stand with their feet wide apart,

possibly on account of muscular weakness and for better support. They walk with a rolling gait, swaying from side to side, balancing over each leg alternately as it in turn rests upon the ground.

Diagnosis. The diagnosis is quite readily made. The movement in walking closely resembles double congenital dislocation of the hips, with which it must not be confounded. They both may exist in the same person.

Prognosis. Good results from mechanical treatment of anterior bow-legs, when well developed, need not be expected. If
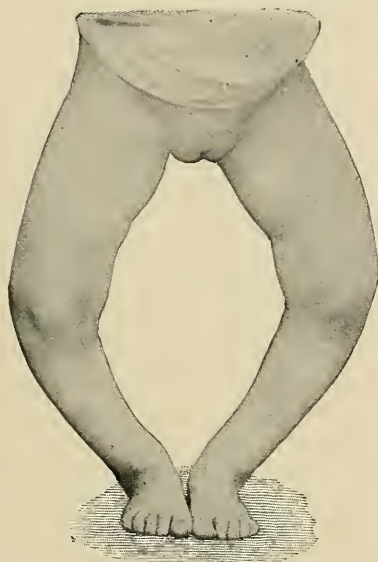
FIG. 152. Bow-legs affecting both femur and tibia. (Park.)

the deformity be noticed early, when the bending is slight, a resort to the proper corrective pressure, with massage, and at the same time keeping the child off its feet, may prevent further bending, and may possibly straighten the bone. But in this, as in all the deformities resulting from rickets, a thorough and vigorous hygienic and medicinal treatment should be adopted and attentively continued until recovery from the disease takes place.

Osteotomy or Osteoclasis is the remedy in confirmed cases.

The prognosis in ordinary bow-legs, where the legs bow out-ward, is more favorable as the result of treatment, and in many slight cases it is favorable without treatment. In those latter cases the arrest of systemic disease, with the hardening of the bones, and other developmental changes leaves slight deformities. A moderate degree of bow-legs is common in some districts, there being not enough of deformity to be noticeable except on close observation of persons while walking.
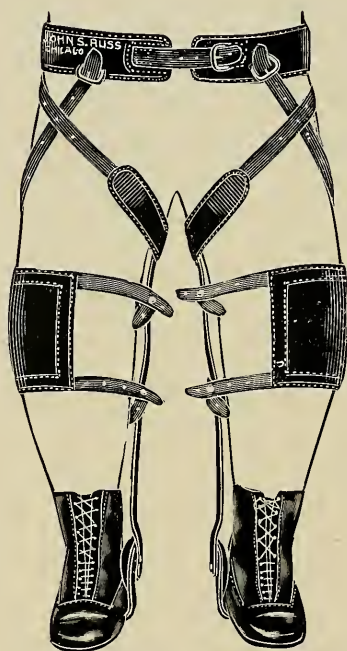
Fig. 153. Mechanical apparatus for the correction of bow-legs.

Treatment. The treatment may be expectant, mechanical or operative.

Expectant Treatment. In slight cases, while the general treatment for rickets is used, the child should be kept under observation as to the special deformity. Frequent tracings on paper of the shape of the limbs should be made and com-pared with one another, so that any increased deviation may be noticed. By the careful co-operation of the parents in

massaging the limbs, to improve the muscular and general
development, good results may be obtained without mechan-
ical aid. Children who walk with a rolling gait, who " toe in"
and stand with their feet wide apart, need more than ex-
pectant treatment.

Mechanical Treatment. This consists of the use of con-
tinuous force in a direction opposite to that of the deviation,
by means of mechanical contrivances. It is suitable for chil-
dren under four years of age, and sometimes for older ones,
if the bones have not become too firm. It is to be combined
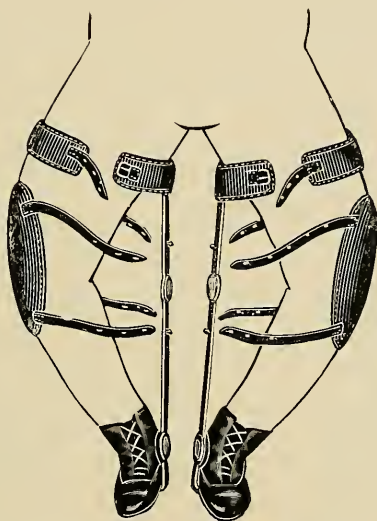
Fig. 154. Mechanical apparatus for the correction of bow-legs.

with the same attention to general treatment as in the former
cases.

The child may be kept in bed, and the knees may be con-
tinuously drawn toward each other by the simple traction of
straps and pads or bandages, the feet being held side by side.
Various forms of elastic spring braces and uprights attached
to the shoe are used, so as to allow the child to be upon its
feet. Of these, the most simple and perhaps the best, as it is
adapted to every need of the case, is a single steel upright
fastened to the shoe and extending up the inner side of the

limb to the upper part of the thigh. It terminates in an
arm running around and upward. The feet can be turned
outward by means of the arms which are fastened to-
gether with straps across the back. A long leather pad
around the outer side of the limb pulls it towards the upright
by means of straps, and the greatest pressure may be made
to bear upon the most prominent part. If the tibia alone be
curved, the brace may be carried only to the knee, and the
pad may be placed at the center of the curve. If me-
chanical means fail, or if the patient when seen is too old
to have it applied, then operative measures are indicated.

Operative Measures. These consist of Osteoclasis and
Osteotomy. They should not be undertaken on children less
than four years of age, or rarely three years.

Osteoclasis. This is a breaking of the bone. It may be
done with the hands, if the surgeon's hands are strong. The
break can not always be accurately located, and hence it is
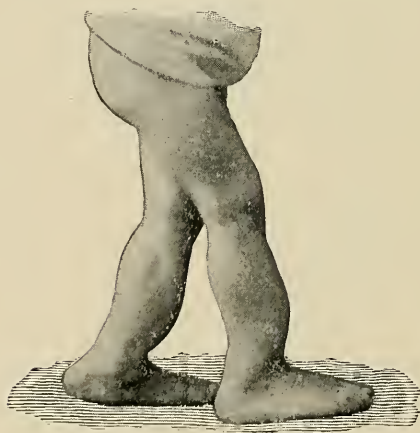
Fig. 155. Anterior bow-legs. (Park.)   Fig. 156. Mechanical apparatus for
                                                      anterior bow-legs.
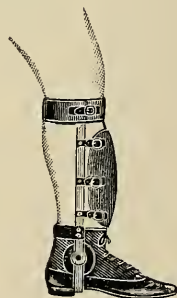
best to use some form of apparatus. The Osteoclast of Rizzoli
is a simple and effective instrument for the purpose. It con-
sists of a bar and two padded rings sliding upon it. A padded
plate is screwed down upon the prominent part of the bend in
the limb between the rings which hold it in the opposite direc-

tion, and the bone is broken at the place of pressure of the plate. Care should be taken that the epiphysis is not separated. The bone is then straightened and done up in a plaster of Paris bandage and treated as a simple fracture.

Osteoclasis is suitable for children over four years of age with anterior bow-legs of a mild grade. The bone is broken as in ordinary bow-legs and straightened and then the tendo-Achillis should be divided and the fixed dressing applied.

Osteotomy. This is a cutting of the bone, and it is done with an osteotome or a thin chisel adapted to the work. It may be linear or cuneiform osteotomy. In the former the bone is cut nearly across and completed by breaking; in the latter, a triangular section is removed and the bone straightened. Osteotomy is to be preferred if the bone be too hard, if the femur be curved, if the tibia be curved in two places or if anterior bow-legs be very marked.

A small incision is made through the soft tissues, opposite the point of greatest curvature, and deepened to the bone; a suitable osteotome is introduced and driven away from important vessels until the bone is nearly cut across. The fracture is completed with the hands. Where the curve is very great, the best results may possibly be obtained by removing a wedge-shaped piece of the bone. In the operation of osteotomy complete asepsis should be maintained, and the bone treated as a compound fracture, to obtain the best results.

KNOCK-KNEE—*Genu valgum*, is a condition in which the knees are more or less approximated and the feet more or less widely separated, the person being unable to place the feet together in standing. The cause is generally rickets; but inward deformity of the knee may result from improper union in fracture, or may result from tubercular disease of the knee. It may be a sequence of infantile paralysis affecting the muscles of the leg, and may be associated with flat-foot, the paralyzed muscles not giving the proper support. It may develop in the adult where the person is of weak muscular and ligamentous development, whose occupation requires long continued standing. It may affect one or both knees. It may be so slight as to almost escape detection, or so great as to

cross the knees with the feet widely separated, the knees interfering in locomotion and producing a wabbling gait.

When caused by rickets, there is elongation of the internal condyle of the femur, making the interarticular line at the knee-joint oblique. There is atrophy of the external condyle, a relaxed internal lateral ligament. and general muscu-

Fig. 157. Knock-knee.

lar weakness. It most commonly begins in children between two and four years of age, and is less common than bow-legs. On account of muscular weakness, they probably place their feet apart and evert them, a position requiring the least muscular exertion. This may also tend to produce flat-foot, which often co-exists with this deformity. Bending of the shafts of

the bones above and below the joint may also occur, increasing the deformity.

Symptoms. If children with knock-knee should walk in the ordinary way, their knees would knock against each other, and progress would be impossible. Hence the swaying gait produced by rotating the legs outward or inward, to lessen the prominence of the inner part of the knees. The "toeing in" or " toeing-out" are among the first symptoms. The deformity disappears on flexing the knee, because it is produced by the greater length of the internal condyle, which is very evident when the leg is flexed.
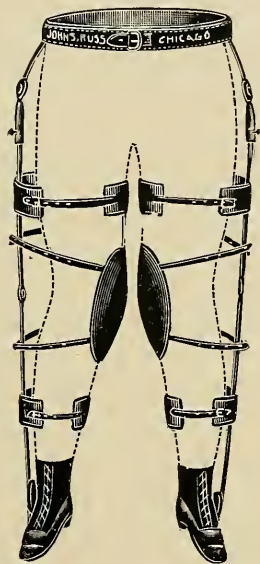
Fig. 158. Mechanical apparatus for the correction of knock-knee.

Diagnosis. The diagnosis is evident on sight, in well marked cases, but when there is flat-foot with knock-knee, care should be taken not to overlook the latter.

Prognosis. The prognosis is not so favorable as in bow-legs, for outgrowing the deformity. Even with the most watchful care, the tendency is to a greater degree of deformity unless prevented by mechanical support.

Treatment. The treatment may be expectant, mechanical or operative.

Expectant Treatment. It is only in mild cases that expectant treatment should be tried. As in bow-legs, the general treatment for rickets should be at once adopted. A tracing of the legs should be made and subsequent tracings compared with it. Massage and manipulation should be used, with attention to the attitude of the patient when standing. The mild electric current should be daily applied to the weak muscles. If there be flat-foot associated with it in the older cases, the arch of the foot should be elevated by the insertion of a steel arch in the sole of the shoe of the affected foot.

Mechanical Treatment. This should be begun primarily, in all cases except the mild ones, and in those when it appears evident that expectant treatment is proving ineffectual. In other cases a cushion may be placed between the knees and the feet bound together, which is sometimes followed by good results. The confinement is irksome and not easily borne, besides being unfavorable to recovery from the rickets. Elastic bands for traction and various kinds of splints have been devised, the general features of all being the same. The limb must not be allowed to be flexed at the knee. To prevent this an upright steel rod, attached to the sole of the shoe and extending up the outer side of the leg and thigh to the pelvis, has attached to the upper end a strong band, which surrounds and is firmly buckled to the pelvis. It is jointed at the ankle and hip, and has a leather pad running around the inner side of the knee, with straps and buckles to pull the knee out to the staff. A posterior arm or broad strap behind and around the leg below and above the knee prevents the knee from being bent.

Operative Treatment. Osteoclasis is not as successful in the treatment of knock-knee as osteotomy. The bone should be broken as near the joint as possible, but the difficulty in applying the best devised instrument prevents accuracy in breaking at the line desired.

Osteotomy.—Of the different methods of osteotomy for the relief of knock-knee, Macewen's supracondyloid is preferable, for in it the bone is severed nearest the joint, without opening it. The chief objection to Ogston's operation, in which the

elongated internal condyle alone is severed, is that the joint cavity is opened, subjecting the patient to all the accompanying dangers.

Macewen's operation is as follows: the patient is placed upon his back, with his slightly flexed knee placed on a sand bag. Two lines are drawn intersecting one another on the front of the thigh. The transverse one is " a finger breadth above the superior tip of the external condyle, and the longitudinal one is drawn half an inch in front of the adductor tendon." A sharp pointed scalpel penetrates the soft tissues to the bone at the point of intersection, and a longitudinal incision is made, long enough to admit the largest osteotome, and the finger if it should be deemed necessary. The osteotome follows the scalpel to the bone, and is then turned transversely and pressed to the back of the internal surface, the scalpel being withdrawn. The osteotome is driven forward and outward towards the outer side. It is then withdrawn somewhat, and directed forward, completing the section of the inner surface, and then again backward and outward, to complete the section of the outer surface. The instrument should be held firmly with the left hand, which rests on the limb, and the section should be carefully done. When this is completed, the instrument is withdrawn and a piece of sponge saturated with a 1-40 carbolized watery solution, is placed over the wound. The surgeon, holding the sponge against the limb as a fulcrum, grasps the limb lower down, using it as a lever, and jerks it if the bone be hard, and bends it if the bone be soft in an inward direction, breaking the rest of the bone.

The operation in this location avoids the synovial sac which extends upward in a tapering form towards the middle. It also avoids any important arteries.

The further treatment, after straightening the limb, is that of a compound fracture. In this operation care is to be taken that complete asepsis is maintained and the result is uniformly good.

CHAPTER III.

PARALYSIS (PALSY).

Definition—Classification—Motor Paralysis—Encephalic, Spinal, Peripheral—
Hemiplegia — Paraplegia — Hemi-paraplegia — Monoplegia — Peripheral,
Local, Multiple.

Paralysis is divisible into motor and sensory paralysis.

Definition. Motor paralysis is essentially the loss of power of voluntarily exciting the contraction of one or more voluntary muscles. Sensory paralysis is the loss of the possibility of transmitting either special or common sensory impressions from their seats of peripheral origin, inward to the center of consciousness in the brain. Paresis means incomplete paralysis.

Motor paralysis is often a chief cause of deformities.

The several kinds are divisible into three groups: (1) those of encephalic origin; (2) those of spinal origin; (3) those of peripheral origin. In the first group the cause is acting upon or within some part of the great center within the cranium. In the second group the cause is acting upon or within some part of the spinal cord. The third group comprises those forms in which the cause is located in the nerves themselves, either within or without the cranium or spinal canal.

(1.) Paralysis of encephalic origin may be produced by change of structure of the cortex of the brain, as a result of inflammation of the grey substance, or of thrombosis or embolism interfering with nutrition, or they may be produced by pressure upon certain portions of the motor tract by tumor, or as the result of hemorrhage. The onset is generally convulsive, often with loss of consciousness. The paralysis is known as *hemiplegia*. It affects the muscles of the face, arm and leg more or less completely, and not those of the trunk, and upon the side opposite that of the disease in the brain;

but it may affect both sides. The patient generally retains
control of the bladder and bowels, unless loss of conscious-
ness persists or the hemiplegia is double. The superficial
reflexes may be diminished and the deep reflexes exalted. The
electrical irritability of the paralyzed muscles is not notably
altered on the paralyzed side of the body.

(2.) Paralysis of spinal origin may be produced by causes
within the cord affecting its structure. Of these, acute mye-
litis is the chief, and thrombosis either of the small arteries or
veins. Embolus and hemorrhage within the cord are more rare.
Extrinsic causes may affect the cord from without, such as
injuries or diseases of the vertebræ, tumors or hemorrhage.
The changes of structure are more or less degenerative and

Fig. 159. Cerebral Paralysis. (Young.)

consist of areas of softening, of processes of sclerosis diffuse
or extending in bands, and in groups of atrophied ganglion
cells and processes. The paralysis is known as *paraplegia*,
and affects the lower transverse half of the body as high as a
certain level of nerve supply. It is common for the control of
the bladder and rectum to be lost, either of both or one of
them. When the lesion is confined to one half of the cord, the
paralysis is on the same side and is known as *hemi-para-
plegia*. *Monoplegia* is paralysis in one part, as facial, brachial
or crural.

(3.) Paralysis of peripheral origin is the result of degen-
eration in the nerve tubules of the nerves, or sclerosis of the
nerves. Injury of the nerve may give rise to inflammatory

processes, or nerves may be severed. Thrombosis or embolism of the vessels may interfere with their nutrition. Atrophy of the nerve cells forming the nuclei at the beginnings of certain motor nerve fibres may extend to their terminations in the muscles. The muscles for want of their normal nerve excitation, in two or three weeks, show marked indications of atrophy. This is preceded by more or less complete loss of irritability of the nerve that supplies the muscles, loss of or diminished irritability of those muscles under stimulation by the Faradaic current, and increased sensitiveness to the continuous current.

A local paralysis is where a muscle or group of muscles supplied by a certain nerve, is paralyzed, and the cause may be in the nerve, or at its center in the brain, or in the spinal cord.

Multiple paralysis is a paralysis of more or less scattered groups of muscles not directly connected with one another, either anatomically or functionally.

CHAPTER IV.

INFANTILE SPINAL PARALYSIS.

Etiology—Pathology—Symptoms—Diagnosis—Prognosis—Treatment.

Infantile spinal paralysis is also known as *acute poleomyelitis* and *acute anterior poleomyelitis.*

Etiology. This is a disease of children, although it may occur at adult life. The disease is characterized by paralysis with complete relaxation, atrophy and alterations of the electrical conditions of the affected muscles. It occurs at ages varying from a month to several years, five-sixths of the cases occurring in children under ten years of age. Males are more subject to it than are females. Although children are attacked more frequently in summer than in winter, yet in so many instances has the attack followed immediately upon exposure that it was probably the cause. Over exertion and over walking are also probable exciting causes. Traumatisms sometimes seem to be the exciting cause.

The functional activity of those parts of the spinal cord from which the brachial and crural nerves arise, is in children so great, inducing constant hyperæmia and excitement, that it may be easily increased to excess, with damage to the structure, and this may possibly explain the frequent occurrence of the disease from the causes named.

Pathology. Autopsies of cases of early death in infantile paralysis, as well as those of late cases, seem to establish the fact of changes in the spinal cord and its nerves. The ganglion cells of the anterior cornua are at first swollen and granular with intense capillary congestion and minute extravasations of blood. This is followed by disappearance of the processes and shrinkage of the bodies of the cells. This atrophy and disintegration extends to the anterior nerve roots,

and involves the anterior column of the cord, especially at the
cervical and lumbar enlargements. The normal nerve tubes
are wasted, stripped of their myelin, often without their
sheaths, while the neuroglia is thickened and increased by
hyperplasia of tissue. In many cases a peripheral neuritis
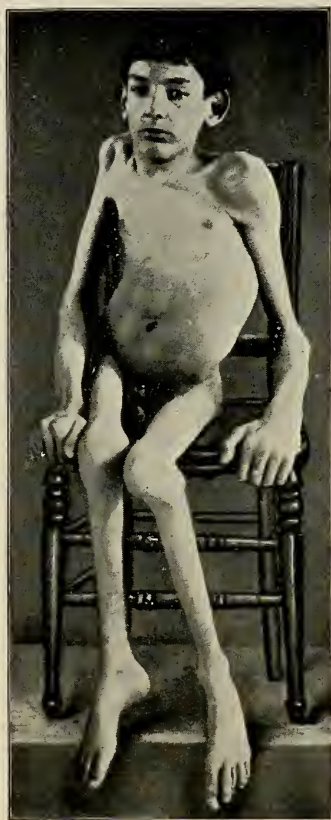
Fig. 160. Severe infantile spinal paralysis. (Young.)

evidently attends the central disease, changing the structure
and destroying the function of the nerves.

The muscles atrophy and undergo fatty degeneration with
disappearance, to a greater or less extent, of the transverse
striæ, and oil globules and fat cells are found between the
fibres.

Symptoms. Infantile paralysis is usually preceded by fever of moderate severity. Vomiting may or may not exist, and pain in the back may accompany it. The temperature may rise as high as 104° Fahr. This disease may attack the patient when in apparently robust health, coming on during the day or during sleep at night, the patient awaking in the morning paralyzed, after a good night's rest. The attack is sometimes accompanied by convulsions, at once followed by paralysis, but without loss of sensibility. There is no constant relation between the severity of the constitutional disturbances and the subsequent palsy.

The lower extremities are generally the first invaded, and the paralysis seldom affects the upper extremities alone. In the beginning it is more or less generalized, but after a time becomes limited to groups of muscles or particular muscles or one member. Even where the paralysis is quite general, the facial, ocular, and respiratory muscles and the bladder are always exempt.

The muscles most prone to be affected are the extensors of the toes, the flexors of the foot, the extensors and supinator of the hand, the extensors of the leg and the muscles of the feet. The paralysis may affect a single muscle as the extensor longus digitorum pedis, the tibialis anticus, the sternomastoid or the deltoid. The part is uniformly cold and there is an actual loss of temperature often of five degrees.

The reflex excitability and electric excitability of those muscles are more or less diminished and sometimes entirely lost. Wasting of the paralyzed muscles begins after a varying period of one to two or more months. It is more rapid than in progessive muscular atrophy, and is proportioned to the loss of electro-muscular contractility. Arrest of bone development and wasting of bone with relaxation of ligaments of the paralyzed limb may occur. After a time a regression of the symptoms begins in the muscles less seriously affected, and their nutrition becomes improved, their volume increases and they recover their voluntary and electric contractility. Those muscles which remain paralyzed, become atrophied, accompanied by granular and fatty degeneration. The active con-

traction of those which have recovered, or that have not been affected, not being opposed by those which have lost their power, contractures of the part occur. These cause more or less deformity which prevent the normal use of the part.

All the varieties of club-foot, knock-knee, inverted knees, rigid flexion of the knees, kyphosis, lordosis, scoliosis, subluxation of the thighs or the humerus, and claw-like distortions of the hands may occur as the result of the paralysis and contractures, and call for the interference of the surgeon for rectification. A withered limb with relaxed ligaments and paralysis of the supporting muscles, may become disarticulated, and remain so because of want of the support that should be given by those muscles.

Diagnosis. It is usually impossible to determine exactly the nature of the disease until the appearance of paresis. If there appears to be no cause for an ephemeral fever, by excluding the exanthematous fevers, infantile fever may be suspected, which is confirmed by the setting in of paralysis. Simple neuritis is excluded by the absence of nerve pain and nerve tenderness.

Prognosis. The extent of the morbid changes which have taken place in the nerve and in the muscles to which they are distributed, determines the prognosis. The earlier the electro-muscular contractility is changed, the greater is the danger of atrophy and permanent degeneration of structure. The failure to respond to the Faradic current is, for all useful purposes in children, a sufficient test of muscular degeneration. If after a week has elapsed the Faradic irritability is retained, the prognosis becomes very hopeful. If it is changed or lost, then paralysis of the part may be expected.

Treatment. When poleomyelitis begins with a violent general disturbance, active measures should be used to lessen the fever and the convulsive tendencies. For this purpose appropriate doses of the bromide of potassium or sodium or the tincture of gelsemium with the hydrate of chloral will be found very useful. The patient should be placed in the recumbent position in bed, and the spine bathed frequently with a liniment composed of equal parts of the tinctures of

belladonna, camphor, chloroform and oil of turpentine. It has been found that a small blister over the region of the spine where it is determined is the seat of the affection, has been useful. Locally the muscular irritability must be excited by the use of electricity as soon as paralysis is evident. The Faradic current must be used as long as the muscles respond to the excitation, and then the Voltaic current must be used, but not enough to exhaust the muscles, but enough to favor the recovery of those that are not too seriously affected. Ergot in proper doses may be used in the earlier stages, to relieve the hyperæmia of the cord, and bathing over the muscles with hot water, followed by friction of the skin and massage of the muscles must be persisted in. Later, the electric current should be continued, and massage, so that by thoroughly kneading the muscles, their activity may be increased. The hypodermatic injection of minute quantities of strychnine is also useful to hasten recovery. The use of such remedies as tend to establish the general health, will improve the local condition. The internal administration of phosphorus as in the hypophosphites, arsenic as in Fowler's solution and iron with strychnine or nux are beneficial for that purpose. Attention to the secretions and excretions, suitable bathing and other hygienic measures are necessary in such cases to secure the best results.

Definition. This is a progressive muscular paralysis in which the muscles appear to be hypertrophied, but the ultimate muscular fibres are atrophied in consequence of the development of interstitial fat and fibrous tissues.

Etiology. This disease is one of boys especially, but few cases having been observed in girls or adults. In many cases it begins in infancy, being manifest as a weakness when the child begins to walk. In a few instances it seems to be hereditary, several members of the same family being affected. Its cause is not definitely ascertained.

Pathology. Several competent observers have been unable to find any changes in the nervous system. Others have observed, in cases of this disease, extensive disintegration of the gray matter at the center of each lateral half of the cord, and in the anterior commissure.

The characteristics that are evident, on inspection of those affected, are an unusual and abnormal enlargement of certain muscles and muscle-groups. The posterior muscles or those used in extending the limbs and supporting the body, are those principally affected. The gastrocnemii, glutei, lumbar muscles, erectores spinæ, and triceps, etc., are so much enlarged as to produce an appearance of deformity. Examination of a small portion taken from a living muscle shows increase of the interstitial fibrous element and fat, and atrophy of the muscular fibres. The hypertrophied muscles subsequently become atrophied, while many of the muscles become wasted without becoming hypertrophied; the two forms appearing in the same person simultaneously. After death

the diseased muscles are found to be composed principally of ordinary fat cells, the true muscular element having largely disappeared. Only a few ultimate muscular fibers remain, some retaining their usual appearance. Others are increased in size, but still showing striation, while a few atrophied fibres have lost their striation and become granular.

In the simple atrophic form of paralysis there are several varieties of a prevailing type. In the juvenile form of Erb, the atrophy begins about the period of puberty and involves the muscles of the upper arm and shoulder and the gluteal and thigh groups, and those of the back are affected later. The calf muscles may be enlarged and hard, while the attitude of the patient is that of the hypertrophied form. In the Infantile form, of Duchenne, the disease sets in usually in childhood, but may be delayed to the twentieth year. In this form, the lower face and forehead are expressionless, and the lips thick and protuberant, moving slowly. The intrinsic muscles of the hand escape, and those of the tongue, pharynx, larynx and eye are not affected by the atrophy. In all the varieties the electrical irritability of the muscles is lessened in direct proportion to the wasting. There is no reaction of degeneration and the sensation is unimpaired. The reflexes are weak and in the later stages, are lost. The sphincters are not involved. Late in the disease, deformities occur such as the various forms of talipes and curvatures of the spine.

Symptoms. When the child is stripped, the existence of pseudo-hypertrophic paralysis is easily determined by the unusual enlargement and hardness of certain muscles, which the wasting of others brings into greater prominence. Another prominent symptom is the protuberance of the abdomen, which is not enlarged, but seems so, owing to the exaggeration of the antero-posterior curvature of the lumbar portion of the spine. There is no disease of the vertebræ, and the deformity disappears when the patient sits or lies down. When he attempts to walk, the heels are elevated, so that he walks as upon tiptoe with legs apart, and balances upon one leg and the other. He soon tires in walking, and if he attempts to go fast he falls, and he is very easily knocked down. If he

stoops to touch the floor, he raises himself with difficulty, and places his hands upon his knees to assist himself to obtain the erect posture.
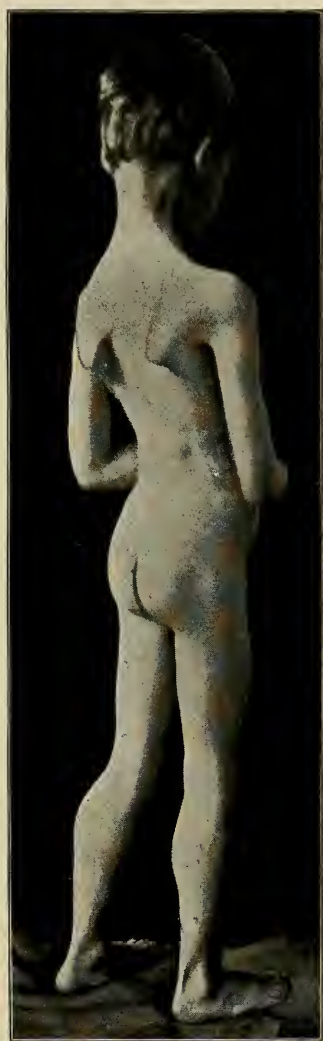
Fig. 161.   Pseudo-hypertrophic muscular paralysis.

According to Duchenne there are three stages in the progress of the disease. The first stage, lasting one or more months or one or more years, is that of mere weakness, with

no enlargement of muscles, but only the peculiarity of attitude. This is the stage, if recognized, in which treatment may be beneficial. In the second stage, which may last for several years, the hypertrophy appears and the weakness extends to the upper parts of the body. In the third stage, there is complete paralysis of the muscles of the lower and upper limbs, and the trunk. The patient lies helpless and unable to change his position, with all his muscles in a state of atrophy.

Diagnosis. The diagnosis is made from the various forms of spinal paralysis, by the evident hypertrophy and hardness of the muscles, and from spinal curvature depending on disease of the vertebral column, by the curvature disappearing when the patient sits or lies down.

Prognosis. The prognosis is very unfavorable, especially after the hypertrophy sets in.

Treatment. In the first stage, some advantage is gained by general tonic treatment, which combines the use of nux vomica or strychnine with the hypophosphites. Locally the use of massage to the muscles, and the persistent use of localized Faradization has in some cases produced improvement and even a cure. Prothetic apparatus may be needed to supplement the action of the weak muscles, so that the patient can go about and have the benefit of the open air in order that the weak muscles may be strengthened by use.

CHAPTER VI.

PROGRESSIVE MUSCULAR ATROPHY.

Definition—Etiology—Pathology—Symptoms— Diagnosis — Prognosis — Treatment.

This disease is a chronic wasting and alteration in the structures of the muscular tissues, due to a slow degeneration of the trophic or motor cells of the spinal cord, with change in the electrical reaction late in the disease. It is also known as *wasting palsy* and *Cruveilhier's palsy*.

Etiology. Progressive muscular atrophy is most frequent in males from the age of twenty-five to fifty. The cause is attributed to heredity in some cases, while in others exposure, overwork, mental distress, syphilis or traumatism may possibly have occasioned the disease.

Pathology. Autopsies of cases that have died, reveal changes in structures of the muscles, nerves and the spinal cord. The changes in the spinal cord consist of atrophy of the nerve cells and their processes in the anterior cornua of the cord, commencing with pigmentary degeneration and ending frequently in their total disappearance. The blood vessels are greatly enlarged and often surrounded with areas of granular and fluid degeneration. These changes affect both gray and white substance, and often extend into the anterior roots of the nerves, which become wasted to a greater or less extent. They extend through the peripheral nerves and terminate in the complete destruction of the motor-fibres of those nerves.

The muscles are at once affected by this disease of the nerve-structures, and their fibres undergo degeneration. It may be simply atrophy of the fibres, or the wasting may be accompanied by granular, or fatty or vitreous degeneration. The transverse and longitudinal striæ disappear to a variable

extent and degree, and the sarcous elements are transformed
into granules often so fine as not to be distinguished from
each other. The granules are soluble in acetic acid. In the
fatty degeneration, the muscular elements are transformed
into fatty particles, and fat cells are found in great numbers
between the fibres, some in groups and some in linear order.
The waxy or vitreous degeneration consists of a transforma-
tion of the tissues into a colorless, glistening, and homogene-
ous substance, in which neither striæ or nuclei exist. All

Fig. 162. Progressive muscular atrophy. (Young.)

the forms of degeneration may exist at once, not only in the
same person, but in the same muscle. The muscle is paler
than natural, or even quite colorless, or it may have a faint
yellow tint.

Symptoms. Progressive muscular atrophy is always
chronic, irregular and capricious in its invasion, and of va-
riable and uncertain duration. In most cases, it makes its
first appearance in the muscles of the right hand—in the

thenar eminence, then in the hypothenar eminence, and then in the interossei. Loss of muscular power in the affected parts is one of the first symptoms, particularly after exposure to cold.

The electric contractility of the wasted muscles may be slightly diminished, but they respond readily to both the Faradic and Voltaic currents. This continues until the wasting muscles reach their final stages, when there are no longer healthy muscular fibres to respond to the current. At an early period the diseased muscles are affected with cramps, and with fibrillar tremors and twitchings, and there is a variable degree of cutaneous anæsthesia, and sometimes there is pain in the muscle before atrophy commences. When the disease begins in the hand, it may gradually ascend the limb and involve all the muscles in succession, extending to the shoulder and to the trunk, and may involve the abdominal muscles and those of respiration and deglutition.

The muscles of the trunk may be involved first, and the arms escape, after which the disease may extend to the lower limbs, but seldom begins there. A variety of changes in the shape and position of the trunk and limbs is produced by the wasting of the muscles, which is not uniform in this disease as in ordinary atrophy from exhausting diseases. The deformity known as claw-hand, from the resemblance of the hand to a bird's claw, is the result of progressive atrophy of the interossei muscles. Glosso-labial paralysis is a progressive muscular atrophy of the tongue, lips, palate and throat muscles from degeneration of the motor nuclei in the medulla oblongata.

Diagnosis. The diagnosis is made from the slow progress of the disease, by its implicating muscles or groups of muscles in succession, and by there being at first only weakness, the paralysis resulting only after the muscular structure is destroyed by the atrophy. The muscles continue to respond to Faradization, which is apt not to be the case in post-paralytic forms of atrophy.

Prognosis. The prognosis is most unfavorable unless treatment may be had at the very earliest stages while there

is only weakness, and before serious changes have taken place in the nerve centers and in the muscles.

Treatment. It is only in the earliest stages that good results may be expected from treatment. If the patient has been exposed to cold and damp, warm baths, and friction and massage should be used. He should be warmly clothed for protection from cold, and the best hygienic measures should be adopted. Over-exertion should be avoided, as a possible producing cause. If it is a result of a syphilitic taint, anti-syphilitic treatment should be given a trial for a time. Since lesions of the spinal cord are attending conditions of the disease, blistering or counter-irritation over the upper region of the spine may be a measure of some benefit. The mineral and vegetable tonics and phosphorus, arsenic and cod-liver oil can be separately used as supporting measures; the greatest advantage is obtained, however, by the use of the galvanic current, applied to the spine in the cervical region, and to the muscles affected.

SECTION VII.
TALIPES.

CHAPTER I.

GENERAL CONSIDERATION OF TALIPES.

Definition—Synonyms—Classification—Mechanical Arrangement—Bones, Muscles, Weight-Bearing Function, Normal Movement.

Talipes, comprises those deformities in which there exists an abnormal anatomical relation of the foot to the leg, or of one part of the foot to the other.

The other common names are *club-foot—Pes contortus.*

The relative motion of the foot at the ankle-joint is that of flexion and extension, and the movements at the joints between the tarsal bones is that of abduction and adduction. Talipes is an irregularity of any of these movements, with a tendency to fixation in the distorted position.

The following classification has been given to denote the character of the deformity.

1. Talipes equinus, or the over extended foot.
2. Talipes calcaneus, or the over flexed foot.
3. Talipes varus, or the over adducted or inverted foot.
4. Talipes valgus, or the over abducted or everted foot.

In addition, terms have been applied to denote an abnormal increase or diminution of the longitudinal arch of the foot.

They are:

5. Talipes cavus, in which the convexity of the longitudinal arch is increased.
6. Talipes planus, in which the arch is diminished or lengthened to some degree.

From a clinical stand-point it is found that such simplicity of arrangement does not always prevail. Usually the deviation is compound and requires a combination of several of the above terms to express the character of the deformity.

The compound forms are:

1. Talipes equino-varus.
2. Talipes equino-valgus.
3. Talipes calcaneo-varus.
4. Talipes calcaneo-valgus.

Before proceeding to the study of the various forms of talipes, it will be well to consider briefly the mechanical arrangement of the foot. It should be remembered that the ankle-joint admits of an antero-posterior motion only. The medio-tarsal articulation admits of a limited amount of motion in all directions. The foot is acted upon by the muscles that have their origin on the leg and their insertion on the foot, to produce extension, flexion, adduction and abduction.

The muscles which move the foot in the four directions may be conveniently divided into four groups.

1. Anterior group.
    Tibialis anticus.
    Extensor longus digitorum.
    Peroneus tertius.

Which act upon the foot as flexors.

2. Posterior superficial.
    Gastrocnemius.
    Soleus.
    Plantaris.
    Peroneus longus.

Which act as extensors.

3. Posterior deep.
    Flexor longus digitorum.
    Tibilis posticus.
    Tibialis anticus.

Which act as adductors.

4. External group.
    Peroneus longus.
    Peroneus tertius.
    Peroneus brevis.

Which act as abductors.

In addition to the function of moving the foot, these muscles play an important part in sustaining the foot's weight-bearing

function. The weight of the body is received from the leg by the astragalus—the highest part of the foot, and transmitted to the ground through the arches. The principal arch of the foot is from the posterior part of the os calcis to the metatarso-phalangeal articulation of the great toe on the inside, and the corresponding joint on the outside of the foot.

In walking, the direction of the weight upon the arches is constantly changing, and it is only through the action of the muscles that the arches are conserved and the elasticity is given to the step.

If the equilibrium or regularity in the action of one or more groups of muscles is disturbed, a corresponding form of talipes will be the result.

CHAPTER II.

TALIPES EQUINUS.

Definition—Morbid Anatomy—Bones, Ligaments, Muscles and Tendons, Skin;
Etiology—Diagnosis—Prognosis—Treatment—Fixation, Tenotomy.

Talipes equinus, or the over extended foot, is any condition which prevents the foot from being flexed at more than a right angle with the leg. Any degree of equinus may exist. The foot may be so far extended that the weight of the body is borne upon the dorsum.

Usually in talipes equinus, the weight is borne on the heads of the metatarsal bones. The heel is raised, and, as the patient walks, the knee is flexed to compensate for the extra length of the extremity. Again, with the knee slightly flexed the muscles of the calf are more relaxed, and the heel is lower than when the leg is fully extended.

Talipes equinus may exist in its simple form, or it may be compounded with talipes varus or valgus. It is more often with talipes varus, and there is also the association of talipes cavus, due to the contraction of the plantar fascia.

The deformity is usually unilateral, although it may occur on both sides. The patient's gait shows a limp, and a jerky step.

The Morbid Anatomy, In talipes equinus, the morbid changes are not as great as they are in some of the other forms of talipes. The bones are altered in position, and direction, but generally not altered in outline. The head of the astragalus is directed downwards and forwards, and often stands out prominently in front. In severe cases the scaphoid and os calcis articulate. The metatarsal bones assume a vertical position, and are usually spread out at their distal extremities. Loss of cartilage occurs where partial subluxation of the articulation develops.

The ligaments on the dorsal surface of the foot are stretched, while on the planter surface they are contracted. The fascia also shares in the same structural change. In severe cases, the posterior ligament of the ankle is shortened, so as not to allow the correction of the deformity without its division.

The muscles and tendons on the anterior aspect are lengthened, while posteriorly they are shortened. In para-

Fig. 163.   Talipes equinus.

lytic cases, the muscles may be degenerated and withered, causing the leg to be very much under size. The tendo Achillis offers the greatest resistance against the reduction of the deformity, and it stands out prominently.

The skin, like the muscles and ligaments, undergoes change anteriorly and posteriorly. In addition, there is usually

the formation of corns, or inflamed bursæ at the points where
the body weight is borne.

Etiology. Talipes equinus may occur either as a con-
genital or an acquired deformity. Usually it is the latter.

In the congenital cases, the deformity is present from
birth, and is usually paralytic in nature. At first, there is no
disturbance of the nutrition of the foot and leg, but as the

Fig. 164.   Talipes equinus with flexion of the toes.

child grows this becomes more apparent. As time elapses the
deformity becomes more fixed.

As an acquired deformity the equinus occurs frequently.
The following may be assigned as the causes:

1. Paralysis, as infantile hemiplegia, or temporary
paralysis from bedridden sickness.

The muscle or group of muscles that is affected by the paralysis, governs the character of the deformity. As a rule the talipes becomes most noticeable while the patient is recovering from the paralysis. It becomes more and more prominent from the fact that the flexors regain their contractile power more rapidly than the extensors. The position of the anterior portion of the foot will also be in accordance with the involvement of the muscles distributed to that portion. Thus the long flexors and extensors determine the flexion or extension of the toes.
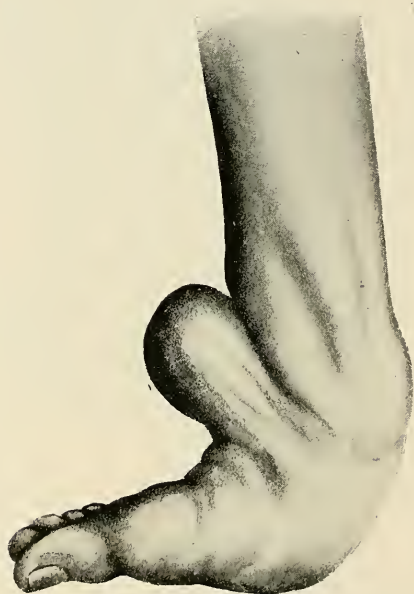
Fig. 165. Severe talipes equinus.

2. Inflammation, traumatic or otherwise, of the ankle, leg or calf.

The inflammation that follows injuries of the ankle-joint very often causes a permanent shortening of the muscles of the calf. The healing of burns, or laceration of the calf, often produces the same result. Rheumatism or tuberculosis of the ankles, sometimes act as causes of talipes equinus. The same may be said of Pott's fracture.

Diagnosis. In severe cases of talipes equinus, there is no difficulty in the diagnosis. In mild cases, some degree of care is necessary. The history of the case should be taken into consideration in connection with the examination. An attempt should always be made to determine whether the con-

Fig. 166. Paralytic talipes equinus.

traction is permanent, or only temporary. It is well to make steady pressure toward flexion, for a few moments, to see if the contraction will not yield. If there is any doubt remaining, it can be determined by anæsthesia.

Prognosis. In talipes equinus, the outlook is generally

good under proper treatment. As a rule, cases never improve without treatment. In severe paralytic cases, the paralysis must be cured before the talipes can be relieved to any advantage. It is always well to take into consideration the cause, in making the prognosis.

Treatment, It may be said that there are two classes of these cases demanding treatment.

1. Cases in which there is no permanent shortening of structures—contracted.
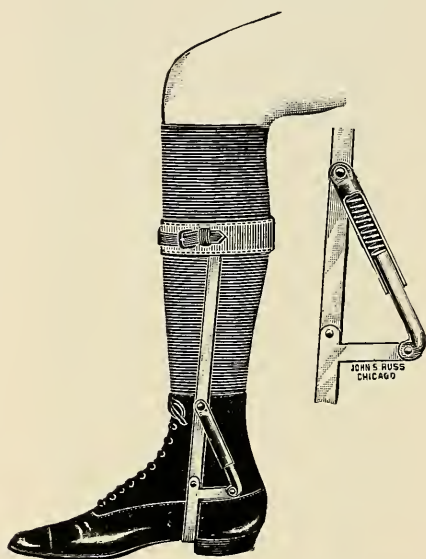
Fig. 167.   Equinus shoe, with ankle brace and spring.

2. Cases in which there is structural change and actual shortening—contractured.

In the first class of cases, if firm gentle pressure is made upon the toes, the foot can be pressed to a position beyond a right angle with the leg. This can usually be done in recent paralytic cases, and in talipes of the new-born. The replacing of the foot in the normal position and securing it there, is all that is needed to effect a cure. This plan should be carried out until the patient is able to walk well. To abandon treatment too early, causes many relapses, and brings many cases

to that condition where operative treatment is the only means of cure.

In reducible cases, fixation apparatus, to hold the foot in position, is indicated. A shoe and brace with a toe elevating spring, should be used in walking, while any ordinary rectangular brace, or tin shoes, must be used at night. The

Fig. 168. Talipes equinus from bed-ridden sickness.

braces should not be applied so as to produce pain. Gentle elastic pressure to hold the foot in postion is best.

The fixation treatment should be supplemented by the use of electricity, massage or exercises, for the purpose of developing the strength and nutrition in the extremity.

Tenotomy of the tendo Achillis, is the operation that is usually called for in talipes equinus. The point usually

selected for the division of the tendon, is about one inch
above its insertion into the os calcis. The skin is punctured,
and a blunt-pointed tenotome is passed below the tendon,
and the cutting is done from within outward. An assistant
presses the foot toward the flexed position so that the resist-
ing structures are held tense. When they are divided there
is a sudden flexion of the foot.
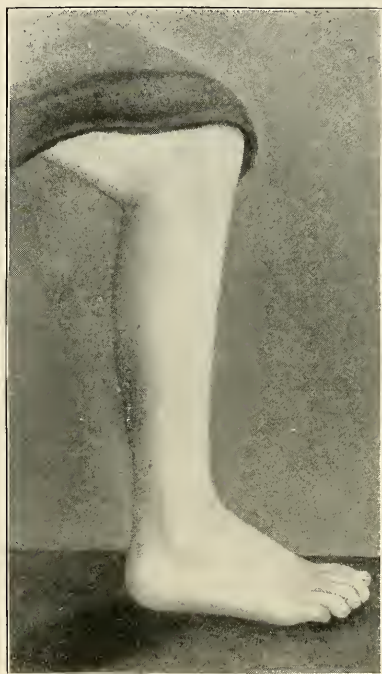
Fig. 169.   Same as Fig. 168.   Corrected by operation.

Where a contraction in the sole of the foot is present, it
is necessary to divide the plantar fascia. This can be done,
sub-cutaneously, by introducing the tenotome, and cutting
the resisting bands where most prominent.

Deformity of the toes, will in many cases need correction.
In cases where they are turned upward toward the dorsum of
the foot, the tendons of the long extensors should be divided

at the base of the toes. If the toes are drawn toward the ball of the foot, the tendons of the long flexors should be divided.

The plaster of Paris bandage, applied to the skin, from the toes to the thigh, forms a convenient means for immediate after treatment. The foot is held in good position until the plaster hardens. The circulation is watched, and if everything goes well, the cast can be removed and re-applied in about ten days.

After the foot is secured in good position, the treatment is to be carried out as suggested above for mild cases.

CHAPTER III.

TALIPES CALCANEUS.

Definition—Morbid Anatomy — Etiology — Diagnosis—Prognosis—Treatment—
Mechanical—Tendon Shortening.

Talipes calcaneus, or the over flexed foot, is an infrequent deformity. Any degree of flexion may exist, from that of a right angle with the leg, to such a degree that the dorsum of the foot rests against the anterior aspect of the leg. The weight of the body is borne upon the heel.

Talipes calcaneus is found more often associated with talipes valgus, or varus, than it is found alone. Like talipes equinus, there sometimes is an accompanying talipes cavus. Talipes calcaneus may be unilateral or bilateral.

In these cases, the gait of the patient is awkward, slow and ungainly. In paralytic cases, there is lameness and weakness of the extremity. The heel strikes the ground first and as the body is thrown forward the front of the foot is brought down with difficulty.

Morbid Anatomy. Considering the extent of the deformity, the tarsal bones are comparatively not much altered. The changes in them is principally in their altered position, and the change in their articulation. The astragalus seems displaced backward. The posterior part of the os calcis is turned downward. In some cases the malleoli are prominent from the flexion of the foot forward.

The anterior ligaments of the ankle are shortened, while the posterior ones are lengthened.

The tibialis anticus, extensor longus digitorum, extensor proprius pollicis, and sometimes the peroneus tertius are involved in the shortening, while the posterior muscles and tendons are lengthened. There is usually some wasting of the leg muscles.

The skin becomes changed, corns or bursitis occurs on the heel, while the toes look delicate and shiny.

In exceptional cases, the plantar structures become much shortened, and in them the tuberosity of the os calcis is brought nearer the ball of the foot.

Etiology. Talipes calcaneus may be either congenital or acquired.

As a congenital affection it is said to be due to intra-uterine pressure or disturbance of some kind. The deformity is easily

Fig. 170. Talipes calcaneus.

reduced in early infancy, when the tissues are pliable. As age advances the deformity becomes permanent unless a cure is effected.

As an acquired deformity, it may follow burns or injuries on the dorsum of the foot and leg, section of the tendo Achillis, or some forms of paralysis.

Diagnosis and Prognosis. There is no difficulty about the diagnosis of talipes calcaneus. The prognosis may be said to

be good in most cases, when treated properly, as the deformity
is quite easily reduced.

In some paralytic cases, and especially when talipes
cavus is associated, the prognosis is bad. Even though the
deformity is corrected, there is such a relaxed condition that
the foot returns to the distorted position. To overcome this
tendency, section of the plantar muscles and fascia, and
shortening of the tendo Achillis have been resorted to.

Treatment. In congenital and mild paralytic cases,
there is a contraction of the soft parts only, which can usually
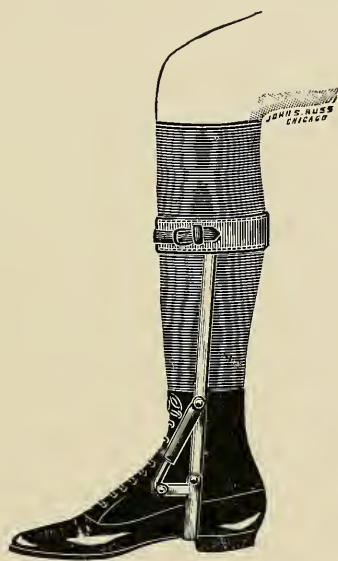
Fig. 171. Calcaneus shoe, with ankle brace and spring.

be reduced by manipulation, but when the force is withdrawn
the foot returns to its deformed position. Some form of reten-
tion apparatus that will assist the weakened muscles in
holding the foot in the natural position, is all that is needed.

The more simple the apparatus, the better it will answer
this purpose. In infants an ordinary bandage might accom-
plish the result. Some simple form of posterior splint of wood
or pasteboard, or the use of plaster of Paris will be found
effectual.

After the toes have been brought down, and in order to assist in walking, a shoe with ankle brace and spring to act in supporting the foot, should be worn.

Whatever form of apparatus is used, it should be removed daily and the parts stimulated by rubbing, shampooing, or electric treatment. Many mild cases may be completely cured by following the above treatment. If a case is severe and does not yield to manipulation, then operative treatment is necessary.

Operative Treatment. The use of the knife must be resorted to in resisting cases, to lengthen the shortened structures, so that the foot can be brought into its normal relation with the leg.

When the muscles and tendons offer resistance, subcutaneous tenotomy should be performed. The tendon of the tibialis anticus should be divided in front of the inner malleolus; the peroneus tertius, just behind the outer malleolus, while the long extensors can be divided at the base of the toes.

After tenotomy, some force can be used in reducing the deformity. In securing a natural position, the plaster bandage is the best means at our command.

When scar tissue on the leg and foot offers a resistance to the reduction of the deformity, it is best to make a careful dissection, removing the scar tissue, and at the same time dividing any resisting bands or tendons. The opening caused by the dissection can afterwards be filled with skin grafts, so as to prevent secondary contraction through the healing process.

The severe paralytic cases are the most difficult to cure. Plans have been devised to shorten the lengthened tendons, so that they will afford the required support to the foot.

Reeves performed an operation in which he opened the sheath of the tendo Achillis, and, after removing the desired segment of the tendon, he brought the ends together and secured them with wire.

Willett performs a modification of Reeves' operation by making a Y incision over the tendon. He cuts off the tendon,

and then removes a wedge-shaped piece from each end. He brings the oblique surfaces together, and secures them with sutures passed through the integument and cut portions of the tendon. When the operation is completed, the united edges of the wound assume a V shaped appearance.

Gibney's modification consists in dividing the tendon obliquely, and slipping the ends by each other and securing them with sutures.

Tubby mentions a Z-method of dividing the tendon through a longitudinal incision. He claims that with his operation there is not the danger of stretching the band of union, as there is in some of the other operations.

Nicoladoni performs an operation whereby he substitutes a healthy muscle for the paralyzed calf muscle. An incision six inches in length, reaching down to the external malleolus, is made along the anterior border of the peroneal tendons. The incision is carried horizontally inwards and a flap raised. A portion of the outer border of the tendo Achillis three inches in length is cut away. The peroneal tendons are cut low down, turned out of their grooves and secured to the freshened surface of the tendo Achillis by fine sutures.

Any plan of operative treatment cannot be expected to do more than to reduce the deformity.

Retaining the foot in proper position, and developing the strength in the weakened structure, must be faithfully carried out as before described.

CHAPTER IV.

TALIPES VARUS AND EQUINO-VARUS.

Talipes varus, or the adducted foot, is rarely seen as a simple deformity. It is nearly always associated with the equinus or the calcaneus.

It is possible for pure talipes varus to occur from a paralysis of the peronei muscles alone, or from scar tissue on the inside of the foot and leg. Sometimes it remains after talipes equino-varus has been treated by operation.

Pure talipes varus is so very unusual that the deformity needs no separate consideration. It will be considered in detail under equino-varus.

Talipes equino-varus is the most common variety of club-foot, and may be either congenital or acquired.

Congenital talipes equino-varus is more often double then single. The deformity is often associated with some other malformation of the child. In these cases it is generally supposed to have its origin in some defective development during the embryonic period.

The appearance of congenital equino-varus is that of elevation of the heel, the foot being adducted and rotated at the medio-tarsal joint so that the sole looks inwards, backwards and upwards. When the child walks, the weight is borne on the outer border of the foot near the base of the little toe.

The affected foot is doubled upon itself, and is smaller than it should be from defective nutrition. The leg is also poorly developed. The inner malleolus is very indistinct and

seems nearly lost in the hollow of the foot, while the external
one is more prominent than natural. In front of the external
malleolus the head of the astragalus is usually quite promi-
nent.

As the patient grows older, the points mentioned in the
deformity become more and more distinct. A slight amount
of talipes varus at the time the child begins to walk is
usually developed into a severe degree of talipes equino-varus.

During the act of walking, one foot must be lifted over the
other, and the patient appears to waddle. This act has given
rise to the name " reel foot." A distortion sometimes exists

Fig. 172.   Double congenital talipes equino-varus.

at the upper end of the femur from the unnatural rotation of
the extremities in walking.

At times the feet become painful or inflamed from walk-
ing, and the patient is compelled to give up exercise for a
time. With boots well fitted to the deformity, much activity
is possible, and many patients prefer to go through life with
this deformity, rather than submit to treatment.

Morbid Anatomy of Congenital Equino-varus. As many of
these cases occur from a defective development, the morbid
anatomy must vary from one extreme to the other. Authorities,
however, are pretty well agreed that in the large majority,
there is a certain form of anatomical change.

In the infant the bones are soft and cartilaginous, but as development continues they become well organized in their unnatural shape. The weight-bearing function in locomotion increases the tendency toward the change in shape.

The os calcis, besides being altered in position, is altered in form. It is rotated from above downward and from without inward. The tuberosity is directed outward and in severe cases is in contact with the fibula. The anterior articulation is bevelled from without inward and backward.

Fig. 173.   Double congenital talipes equino-varus with inflamed bursæ where weight is borne.

The astragalus is changed in form. A transverse section shows that it has lost its square form and has assumed a trapezoidal shape. It is tilted forward and downward and the anterior portion is prominent on the dorsum of the foot. The neck of the bone is deflected inward and the articulation, in consequence, is somewhat lateral instead of forward.

In severe cases a new facet may form for articulation with the misplaced scaphoid.

The scaphoid is drawn upward, inward, and backward. It is often in contact with the internal malleolus and new facets may form on the bones where they articulate.

The cuboid becomes somewhat more quadrilateral than

Fig. 174.　Skiagraph of a case of congenital talipes equino-varus.

normal. Its dorsal surface becomes somewhat hypertrophied and appears prominent on the external margin of the foot in some cases.

The cuneiform and metatarsal bones, and phalanges are not much altered, except in position. They are inverted and more developed on the dorsal surface. The first phalanges are usually extended, while the others are flexed.

The ligaments are enlongated on the dorsum and external border of the foot, while on the internal border and on the sole, they are shortened. The posterior ligament of the ankle-joint is also shortened.

No doubt the resistance offered by these shortened ligaments, forms the greatest barrier to successful treatment. Tubby states that the most important and resisting one is the anterior part of the deltoid ligament. The plantar fascia and the ligaments of the sole of the foot undergo shortening and contribute their part to the deformity.

Fig. 175. Skiagraph of a case of double congenital talipes equino-varus.

The muscles and tendons.—The muscles are usually healthy at birth, but they do not develop correspondingly with the rest of the body. The tendons are displaced according to the degree of the deformity. The tendon of the tibialis anticus is displaced to the inner side. The tendon of the tibialis posticus, at the point usually selected for its division —just above the inner malleolus, is placed farther forward

than in the normal foot.   The tendo Achillis, owing to the lat-
eral obliquity of the os calcis is nearer the internal malleo-
lus than normal.   These tendons are all shortened by the
contracted muscles, while the peronei muscles and tendons
are lengthened.
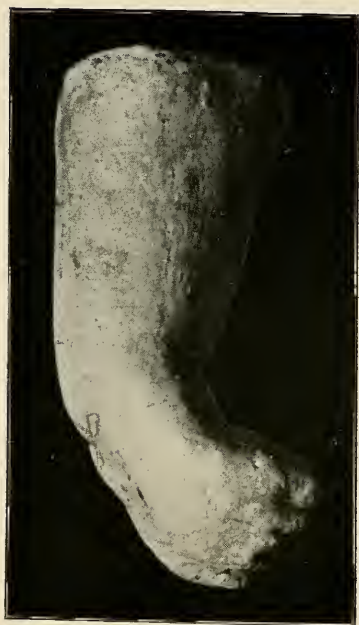
Fig. 176.   Congenital talipes
equino-varus.

Fig. 177.   Acquired talipes
equino-varus.

In severe cases the posterior tibial artery and nerve are
misplaced towards the inner malleolus.

The skin and subcutaneous tissue over the external bor-
der of the foot where the weight is borne, becomes much

thickened and numerous corns and calluses form. Inflammation and suppuration often occur. The surface of the leg and foot looks anæmic from defective nourishment.

Acquired talipes equino-varus may be either single or double. More often it is single, or much more marked in one foot than in the other.

The appearance of the acquired variety, is similar to that of the congenital form, excepting that generally the foot is not so much contracted and doubled upon itself. The relation of the foot to the leg, and of one part to the other, is very much like a case of congenital equino-varus in a mild degree.

In the acquired equino-varus the anatomical structures are not so much altered as in the congenital. The bones remain unchanged, except in position. The alteration in the ligaments, muscles and skin, are similar to a mild congenital case. There is a great variation in regard to the paralysis of the muscles. In some cases the paralysis is but partial, and the foot is drawn toward the strong flexors. In other cases some of the muscles may have undergone fatty degeneration.

Etiology of Equino-Varus. Congenital equino-varus has its origin in a defective development during the embryonic period.

Acquired equino-varus develops secondary to some form of paralysis; very rarely it is traumatic as the result of fracture, dislocation or separation of the epiphyses at the lower end of the tibia and fibula. A mild form of equino-varus comes on with any severe inflammatory process in the ankle and medio-tarsal articulations.

Infantile paralysis, is probably the cause of the greatest number of acquired cases. The deformity develops from the irregular action of the muscles during the period of convalescence from the paralysis. The peronei and other of the extensors are most affected by the paralysis, while the opposing muscles have sufficient contractile power to divert the foot in their direction. Hence we have the raising of the heel by the gastrocnemius and soleus and the inversion of the sole by the tibialis posticus and anticus and the flexor longus digitorum.

Hemiplegia, primary lateral sclerosis and muscular atrophy act similarly to infantile paralysis in causing the more obstinate forms of equino-varus, while reflex irritation such as often comes from teething, genital irritation and convulsions, produces a temporary deformity.

Fig. 178.   Acquired talipes equino-varus, from paralysis.

Temporary paralysis from protracted bed-ridden sickness causes a " dropping " of the feet and has been called *talipes decubitus.*   The weight of the bed clothes usually contributes to this condition.

Diagnosis. The history will usually serve to distinguish between congenital and the acquired talipes equino-varus.

In the congenital cases we have the deformity from birth, and it is usually double; the circulation is fair and the muscles respond to electrical reaction. The furrows in the foot are marked.

Fig. 179.   Same as Fig. 178, front view.

In the acquired or paralytic cases, the affection is first noticed following some sickness, as measles, diphtheria, teething, convulsions, etc. It is more often single and usually there has been a paralysis of the whole extremity and pos-

ibly the upper extremity, and muscular wasting and shorten-
ing of the leg and foot due to defective nutrition. The
circulation is poor and the skin clammy. In severe cases
electrical reaction may be lost.

Prognosis. It may be generally said that the prognosis
is favorable under treatment. The questions that will natu-
rally arise are as follows:

1. Can a shapely foot be obtained from treatment?

2. Will the foot permit of an easy and natural gait in
walking?

3. What are the possibilities of relapse?

4. How long a time should the treatment be continued?

Fig. 180. Talipes equino-varus, ex-
ternal surface of foot.

Fig. 181 Talipes equino-varus,
internal surface of foot.

1. Can a shapely foot be obtained from treatment?—This
will depend upon the character of the deformity, and the age
at which treatment is administered. If there is only a moder-
ate degree of deformity, a perfect foot may result from treat-
ment. The greater the degree of the deformity, the more
dwarfed the foot will be when the equino-varus is reduced.

A patient is never too young to receive treatment for equino-varus, as, the longer the deformity remains, the greater will be the tissue change and the more difficult it will be to make a correction.

During the tender age of childhood, the bones are largely cartilaginous, the ligaments are elastic, and the shortened structures yield readily to treatment. The earlier the treatment is begun the better the shape of the foot will be, and the more favorable the prognosis.

2. Will the foot permit of an easy and natural gait in walking?—This will also depend upon the age of the patient and the extent of the deformity. In the more severe cases where extensive operative interference is necessary, the prognosis in this respect is not so good. In acquired cases the patient's gait will depend altogether on the cure of the paralysis, or the entire removal of the cause of the talipes. Oftentimes this cannot be accomplished except by the constant use of a supporting apparatus.

3. What are the possibilities of relapse?—Relapses frequently occur as the result of imperfect treatment. A case that is only partially cured is sure to relapse. Cases that have been operated upon and the deformity not effectually reduced at the time of the operation, will return, and if left for a time will be as bad as ever. In many cases the patient passes out from under the observation of the surgeon and is neglected, and the deformity returns. A partially relapsed case should be again subjected to treatment and carefully watched until cured.

4. How long a time should the treatment be continued?—The duration of the treatment, will depend upon the nature of the case. If the case is severe, and there is much paralysis it will be necessary to follow up the treatment through adolescence. In every case of equino-varus, careful attention should be given to it until the growing period is passed. The deformity may have been wholly reduced at an early date, but if the case receive the proper attention much improvement can be made in the gait of the patient, through instruction and the support of properly fitting braces.

Treatment of Talipes Equino-Varus. The two great objects to be accomplished in the treatment of talipes is (1) to reduce the deformity; (2) to keep the foot in a natural and useful position.

As to the reduction of the deformity, the various methods that are practiced by surgeons are too numerous to be described in this place. Let it suffice to say, that the ad-

Fig. 182. Treatment by manipulation.

vantage gained by a rapid reduction of the deformity, gives this method precedence over that of the gradual and slow procedure.

There are two general classes of cases, each requiring a decidedly different plan of treatment. They are:

1. Cases where the deformity can be reduced by manipu-

lation, and the most that is needed is retention and treatment to develop the weakened structures.

2. Where the deformity cannot be reduced by manipulation, and demands some form of operation to bring the foot into a natural and useful position.

To distinguish between these two classes, the surgeon grasps the foot and makes firm and steady pressure toward
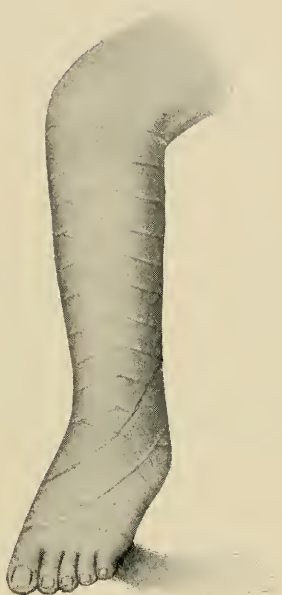
Fig. 183. Bandage applied to correct talipes equino-varus.

the normal position. If the deformity yields, the case belongs to the first class. Under anæsthesia, or complete relaxation, the first class is reduced without resistance. The tissues are simply contracted. In this class of cases an operation would but tend to increase the deformity.

In the second class the deformity may be partly reduced by manipulation, but beyond a certain point the foot is rigidly held by the shortened tendons and ligaments.

1. The first class includes the most simple form of talipes equino-varus. Congenital cases, where treatment is com-

menced shortly after birth, and mild acquired cases where no
structural change has taken place to prevent an easy reduc-
tion.

In congenital cases the plan is accomplished by:

     (a.) Manipulation.

     (b.) Bandages.

     (c.) Braces.

(a.) Manipulation by the hands of the mother or nurse,
is nature's method. Dr. Phelps has well said that " the best
orthopedic machine ever devised is the human hand; guided
by intelligence, as it applies forces for the correction of
deformity more delicately, and perfectly, than any means ever
invented." Frequent manipulations will cure many cases if
diligently followed for a time after birth.
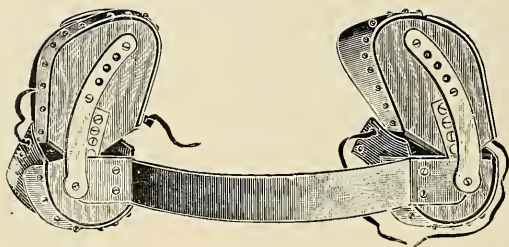
Fig. 184.   Braces for double talipes equino-varus in infants.

(b.) Common bandages applied to the extremities in such
a way as to hold the foot, will often accomplish much, es-
pecially, in connection with manipulation.

In these cases where the manipulation and bandaging
cannot be properly attended to, much good can be accomplished
by the application of plaster bandages. In infants they should
be changed every week or two.

(c.) Club-foot braces, or some suitable form of club-foot
shoe, should be used as soon as the child is old enough to
learn to walk. The retention in the corrected position, should
be effectual, and this, without producing pain to the patient
while walking.

The club-foot shoe, made with good substantial braces
forms the best means of treatment for the mild forms of ac-

quired equino-varus. The apparatus acts as a support to assist the paralyzed muscles in holding the foot in its natural position.

In all cases the support should be worn until the patient has sufficient power over the extremity to be able to walk well without it.

To develop the weakened structures, the patient must have well directed exercises. Douching, rubbing, and electricity, such as advocated for the cure of paralysis, is to be followed out diligently.

2. The second class of cases are the more difficult ones in which to make a cure, as they are usually those that have been neglected, or have been badly handled by other physicians.

Cases of this class demand operative treatment. The operation should be supplemented by forcibly restoring the foot to a normal position, and later, following this for a long time with retention and development, by the same methods as are suggested for the first class.

Operative Treatment. The operative treatment may be included under the following headings:

(a.) Tenotomy, with the subcutaneous division of the resisting tissue—fasciotomy and syndesmotomy.

(b.) Open incision—division of the resisting tissue— Phelps' operation.

(c.) Tarsal osteotomy—tarsotomy and tarsectomy.

(a.) *Tenotomy for equino-varus* should be performed under the influence of anæsthesia, and all aseptic precautions observed. The subcutaneous method is to be employed. At the same time that the tendons are divided, all resisting bands of fascia and ligaments are to be severed, so that the deformity can be reduced.

The cutting of arteries is to be avoided if possible. While the hemorrhage from a divided artery is easily controlled by a compress held by the dressing, the circulation in the foot at first is much retarded by the division.

In many cases of congenital equino-varus, the displacement of the tendons and arteries, under an abundance of fat,

makes tenotomy somewhat difficult. Effectual and thorough work must be accomplished, as the partial division of a tendon, does not give good results.

Tubby advocates that the tendons be divided at two operations. 1st. Reduction of the varus by division of the tibialis anticus and posticus; 2d. At a later operation, reduce the equinus by the division of the tendo Achillis. The writer makes it a point to divide all the resisting structures at one operation. Step by step, each tendon is divided, together with
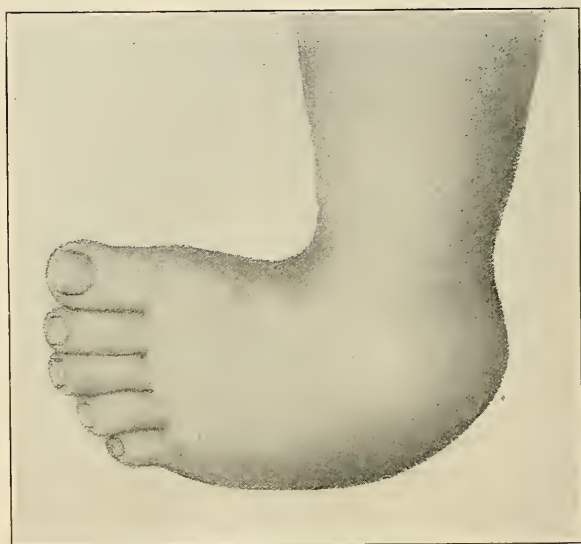
Fig. 185. Congenital talipes equino-varus.

its accompanying bands of adhesions, until the foot can be forced into an over corrected position.

In operating, the plantar fascia, if it is contracted, is divided after the same manner as described under the subject of talipes cavus.

Tenotomy of the Tibialis Anticus. This tendon is the next to be divided. It should be remembered that this tendon is sometimes displaced internally, but it can usually be felt. The point at which to insert the tenotome, is where the tendon is felt to be the most prominent, on the inner aspect of the

foot, in front and a little below the point where it passes the internal malleolus. The tenotome is held flat and passed underneath the skin, and turned with the cutting edge against the tendon. Its successful division is shown by the sudden loss of resistance to the knife and a diminution in the deformity.
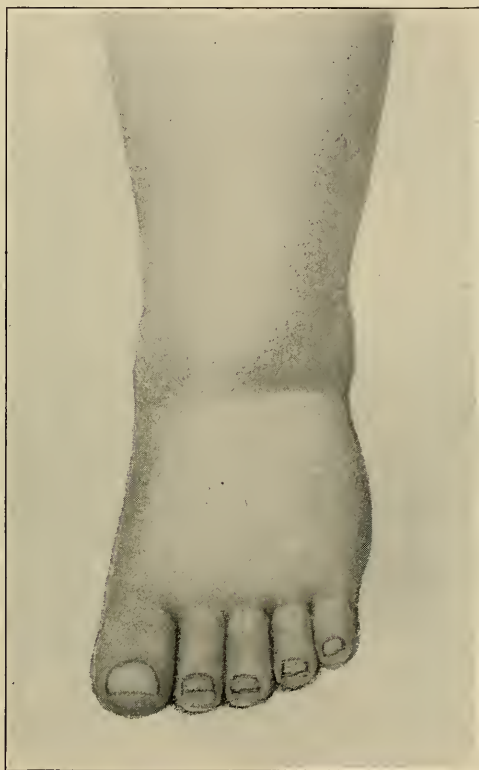
Fig. 186.   Showing result of tenotomy and forcible replacement of same case as Fig. 185.

Tenotomy of the Tibialis Posticus.   The division is best performed above the annular ligament, on the internal aspect of the leg. The puncture is to be made at a point one or two inches above the tip of the internal malleolus, and exactly midway between the anterior and posterior margins of the leg. The blunt tenotome is to be passed vertically into the tissues

with the flat of the blade towards the bone, until the inner edge of the tibia is felt. The cutting edge of the knife is then turned backward toward the tendon. The assistant then flexes and abducts the foot while the operator makes a very slight motion with the knife. The tendon gives way with a sudden jerk and the foot is capable of more eversion.

If on withdrawing the knife, bright red blood flows freely the posterior tibial artery has been wounded, while oozing of dark blood would indicate that the internal saphenous vein has been injured. The cutting of either of these is not of much importance as the hemorrhage is easily controlled by a compress held with a bandage.

Tenotomy of the extensor longus pollicis. This is usually accomplished on the dorsum of the foot, about midway between the ankle and the base of the great toe. The knife is passed under the tendon from without inward. When the tendon is cut the great toe becomes flexed.

Tenotomy of the tendo Achillis. This has been described under talipes equinus.

Division of the ligaments —syndesmotomy and fasciotomy. The division of all resisting bands of fascia and ligaments is best accomplished subcutaneously. For equino-varus the tenotome can be passed through the skin in front of the internal malleolus and with the cutting edge inward, and the point downward the tendons of the tibialis anticus and posticus, the astragalo-scaphoid ligaments, and the contracted fascia can be easily divided. The foot is abducted and inverted by an assistant while the resisting tissues are being cut. While the superficial fibers are divided, deeper ones come into play, and must, in their turn, be cut until the bone is reached.

In some very severe cases it may be necessary to divide the posterior ligament of the ankle-joint, in order to correct a severe congenital equinus.

The reduction of the deformity after more or less subcutaneous division of the tissues, is best accomplished with the hands. Usually considerable force is necessary to produce the proper moulding of the foot in the over corrected position.

Thomas and others have used wrenches to force the foot into position. According to the experience of the writer it is better to do more extensive cutting, than to cause too much traumatism of the skin with the wrench.

Retention after operation, demands great care on the part of the attendants. Whether or not to dress the foot in a fully corrected position at the time of the operation, is a question to be decided in each case. It will depend upon the circulation.
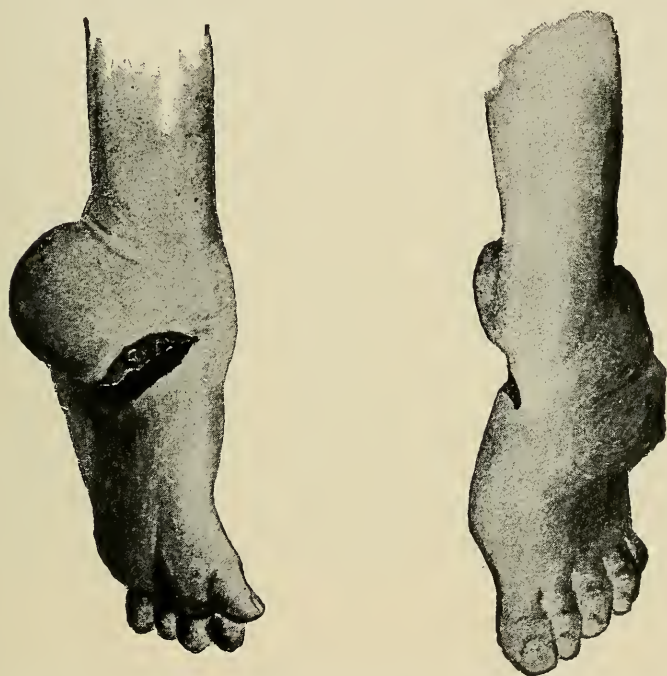
Fig. 187.   Phelps' operation for talipes equino-varus.   (Young.)

In severe equino-varus the correction of the deformity may so compress the arteries that there is some danger of death of the part, from an arrested circulation. If so, it may be well to partly reduce the deformity at the first dressing, and, at each redressing bring the foot farther toward the natural position.

All wounds in the skin should be carefully sealed with some form of antiseptic dressing. Over this a plaster of Paris

bandage should be applied, from the toes over the foot and leg, to some point above the knee. While the plaster sets, the foot is held in a safely corrected position. The nurse must watch the circulation in the toe nails, which have been left exposed for that purpose. If at any time after the plaster hardens, the circulation is arrested in the toes, the cast should be removed and one applied with less correction.

If all goes well the plaster dressings are continued until all sensitiveness has disappeared. During this time they are to be changed every ten days or two weeks.

From this time on, the patient is to receive the same treatment as has been outlined for the reducible cases, or class 1.

(b.)   *Open incision—Phelps' operation.* The open incision may offer some advantages, especially when the skin will not yield to the stretching that is necessary in order to reduce the deformity.

After an Esmarch's bandage is applied, and the foot made aseptic, the incision is made from a point in front of the internal malleolus, downwards, and outwards, into the sole of the foot.

Through this incision the following tissues can be cut, as the assistant produces abduction and eversion of the foot: tibialis anticus and posticus, abductor pollicis, plantar fascia, flexor brevis, the long flexors and the required portion of the deltoid ligament. The tendo Achillis is divided subcutaneously.

The result of the open incision, and the forcible correction produces a deep and open wound which most operators leave to heal by granulation. The dressings, and the foot are held by plaster, to insure a corrected position.

Phelps removes the constrictor after the dressings and plaster are all applied, so as to secure a blood clot in the wound.

This operation, if well followed by the required treatment has the advantage of lengthening the foot somewhat. It offers an easy method of getting at all the shortened tissues and dividing them in plain view. On the other hand there is some danger of the cicatrix assisting in the causation of relapse.

(c.) *Tarsal Osteotomy—Tarsotomy and Tarsectomy.* The numerous cutting operations upon the bones for the relief of talipes equino-varus are generally included under tarsotomy and tarsectomy. The former, tarsotomy, consists in the division of the bony structure of the tarsus; the latter, tarsectomy, consists of the removal of a wedge-shaped piece of bone from the tarsus.

Fig. 188. Phelps' operation for talipes equino-varus, showing result. (McKenzie.)

To these might be added the operations of resection of one or more tarsal bones.

Many plans of operating upon the tarsus have been devised for the details of which the reader is referred to the works by Young, and Bradford and Lovett.

Tarsotomy of one or more bones, so that in correcting the deformity the sections will allow the foot to be easily replaced, has been of assistance in certain selected cases.

Tarsectomy, as an operation, presents no difficulty, but the results following it, have not, as a rule, been satisfactory. This is undoubtedly due to the clinical fact that a tarsal

bone is very slow to recover after having been severely disturbed by traumatism and inflammation.

Resection of the astragalus—Astragalectomy (Lund's Operation). This operation, from all reports, would seem to have a clinical advantage over all others for severe equino-varus. Even this operation, should not be performed if the other and more conservative means of treatment will reduce the deformity.

Tubby describes the operation as follows: " An incision is made into the bone, from the tip of the external malleolus downwards and forwards, passing between the peroneus tertius and brevis. After raising the soft tissues with an elevator, the ankle and astragalo-scaphoid joints are opened. The astragalus is then freed from its ligamentous attachments and is removed. If any difficulty arises in bringing the foot to the right angle, the anterior extremity of the os calcis, or a piece of the external malleolus, must be removed. The wound should be closed entirely, and the foot put in plaster of Paris for a month, and then passive movements employed so as to obtain mobility at the ankle."

CHAPTER V.

TALIPES VALGUS.

Definition—Morbid Anatomy—Etiology—Diagnosis—Prognosis—Treatment—
General, Operative, Mechanical.

Talipes valgus, also known as flat-foot and pes planus, is a dropping of the arch, and an abduction, or eversion of the front part of the foot.

The twisting is at the medio-tarsal joint. The inner border of the foot is lower and convexed, while the outer is concave and in some cases, the sole is turned outwards.

Talipes valgus, is often associated with congenital talipes calcaneus, and sometimes with the equinus. In by far the greater number of cases, it exists simply as the loss of the arch of the foot, and, the eversion that is necessary with such a change in anatomical relationship.

In young children, talipes valgus can be very often noticed when the child is learning to walk. The toes are turned outward and there is no elasticity in the step. The deformity is usually about the same degree in both feet.

In the adult, the foot is long and flat, the internal malleolus is unusually prominent, and, when standing and walking, the body weight is largely borne on the inner margin of the foot, midway between the heel and ball of the great toe.

Inflammation and even suppuration sometimes occur from the unnatural pressure at this point from walking, thus giving rise to a very unpleasant complication. Pain is often a distressing symptom. Its character is not uniform; at first it is only a feeling of fatigue, succeeded after a time by a dull aching. After resting the pain passes away, but, on resuming the standing posture it returns. It is due to the stretching of the ligaments, and to unnatural pressure.

The gait is slow, awkward and without the elastic step of health. The foot is involuntarily kept stiff and the patient appears " wooden-footed."

Morbid Anatomy. The bones are altered in position, but very little, if any, in shape. In some cases the head of the artragalus and the scaphoid may be slightly altered from the unnatural pressure. In rare cases the bones have become carious from irritation and inflammation, induced by walking.

Fig. 189. Double talipes valgus.

The ligaments, that are elongated, are the internal lateral ligament of the ankle, the calcaneo-scaphoid, astragalo-scaphoid and the scapho-cuneiform. The plantar fascia also participates in the elongation.

The muscles that are stretched, or paralyzed, are the tibialis anticus, and sometimes the tibialis posticus and the extensor proprius pollicis. The opposing muscles, or the shortened ones, are the peronii, and sometimes the extensor communis digitorum.

In some cases of paralytic valgus, there may be a variation from the above anatomical changes, in that the foot may be everted without the arch being destroyed.

Etiology. Talipes valgus may be either congenital or acquired.

The causes of congenital valgus must be traced to the embryonic period. Such children often present other congenital defects. Numerous cases are recorded by American and foreign surgeons, of partial absence of the fibula with an extreme degree of valgus. Any congenital defect in the bones of the leg, as shortening, or an anterior curve, will have talipes valgus associated with it.

It has been observed that nearly all infants, on beginning to stand and walk, have a physiological flat-foot. The arch is not acquired until the muscles of the leg and foot have become developed.

The cases of acquired talipes valgus probably exceeds in number any other form of talipes. Talipes valgus occurs at any period in life, from the time the child learns to walk, until the period of adolescence. It is caused by the weight of the body being borne on structures which have been weakened by:

Paralysis.

General muscular weakness.

Rickets.

Traumatism.

Ankle-joint disease.

Diseases of the bones of the foot.

Paralytic talipes valgus, produces the derangement in the tension and nutrition of the muscles. In some cases it is progressive, and in others, not. According to Volkmann, the majority of these cases recover from the paralysis, but the foot remains in the deformed position.

General muscular weakness, arising from any debilitating sickness, from over taxation of the strength of the foot in standing, or from adolescence, contributes to the deformity. The great amount of work thrown upon the weakened tissues causes the muscles and ligaments to become relaxed under the pressure of the body weight.

In rickets there is a weakness of the muscles, as well as a disturbance in the nutrition of the bones. The deformity develops from over pressure on the weakened structures, and remains as a latent symptom of the previous disease.

Traumatism, such as Pott's fracture, sprains of the medio-tarsal joint, and burns on the outside of the foot or leg, often produce the deformity.

Fig. 190.   Talipes equino-valgus.

In diseases of the joints and bones of the foot, the position assumed, corresponds to that of talipes valgus, or equino-valgus.

Diagnosis. Talipes valgus is often entirely overlooked. The awkward gait, and inelastic step, should suggest an examination. If printers' ink be applied to the soles, and the patient walk on paper, the tracings will reveal the true nature of the deformity.

The pain of flat-foot should not be mistaken for rheuma-

tism or gout. A careful examination will establish the cause
of the pain, and the nature of the deformity.

Prognosis. The prognosis must necessarily vary with the
cause, the amount of deformity, and the length of time it has
existed.

In traumatic, rhachitic and long standing cases, the prog-
nosis is unfavorable. In late cases, of paralytic origin and

Fig. 191.   Talipes valgus, or flat-foot.

those arising from muscular weakness, treatment will do
much to cure the deformity.

Treatment. Congenital talipes valgus can most usually
be cured by manipulation. If, however, there is some re-
sistance, force may be applied with the hands, and the cor-
rected position of the foot secured with bandages.

When children begin to walk, some attention should al-
ways be given to the management of the feet. If valgus is
present, the heel of the boot should be slightly raised on the

inner side, and carried further forward than on the outer side,
so as to give support to the arch of the foot. As the patient
grows older, an ankle, or leg brace, should be used in con-
nection with the boot, as described above. In severe cases,
the brace should go above the knee to the thigh, or to the
pelvis, to prevent the patient from everting the foot.

The condition giving rise to talipes valgus, should be as
speedily removed as possible. If paralysis is the cause, it is
to be treated in the same lines as paralysis elsewhere, with
due attention to the restoration of the deformity.
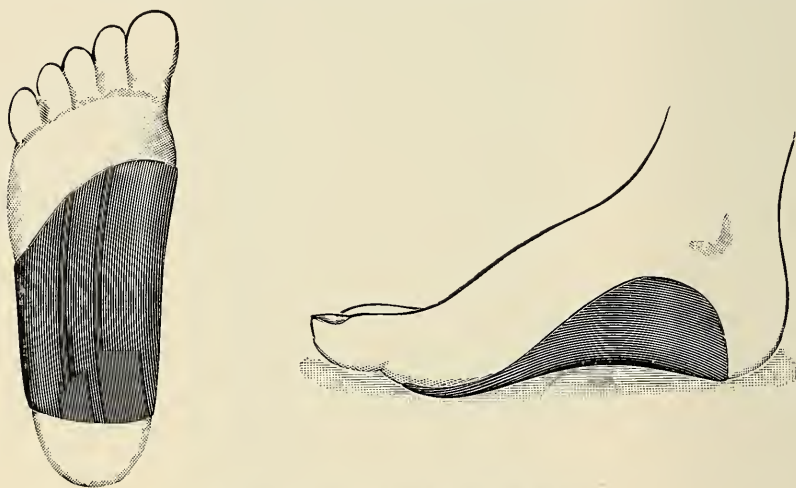
Fig. 192.   Sole plates for talipes valgus.

If due to muscular·weakness, the body muscles should
be strengthened by all conservative means of treatment at
hand. If due to rickets, constitutional remedies and support
to the arch of the foot should be employed.

In inflammation from traumatism, and joint affection, the
treatment should consist of proper support until the disease
is cured; afterwards the treatment is the same as in other
severe cases of talipes valgus.

As a rule valgus can be reduced by manipulation and
without any operation. However, some severe cases may be
met with where the deformity will be found to be extremely
difficult to reduce; here an operation is demanded.

Tenotomy of the peroneal tendons, is accomplished by puncturing the skin behind the external malleolus, and by introducing a blunt pointed tenotome between the tendons and the bone, and cutting toward the skin, care being taken not to enlarge the skin opening. The proper division is evidenced by a giving way, as the assistant makes traction on the tendons by inverting the foot.

At the time of the operation, some force may be necessary to mould the foot into the normal shape. An attempt should be made to force the arch and bring the ball of the foot nearer the heel. Plaster of Paris can be applied to secure what is gained by the operation, until the sensitiveness disappears, so that the patient can wear properly fitting shoes and supports.

Supports for talipes valgus, have been devised in many forms. They are to be worn in the shoe, in such a way, that they support the arch and retain the natural shape of the foot. Probably a modification of Whitman's valgus sole plate will give the best satisfaction when well adjusted in the shoe.

The valgus sole plates are made as follows:

The flat-foot, is by manipulation replaced as far as possible toward the normal position. The foot being at right angles to the leg, a plaster cast is taken, on which the lines of the plane are drawn. The point A is made beneath the ball of the great toe, just short of the bearing center. B at the heel, C just above the head of the astragalus, and D on the outer aspect of the foot.

The plate should be accurately moulded in the cast, and its margin represented by a line A, B, C, D, so that it will fit the contour of the sole, with the arch raised. Aluminum is a convenient material for the plate. It should be worn inside of the shoe for a long time, until the correction has produced a permanent cure.

TALIPES CAVUS.

Definition—Etiology—Artificial Talipes Cavus—Morbid Anatomy—Diagnosis—
Prognosis—Treatment—Mechanical, Operative.

Talipes cavus, or pes cavus, consists of an elevation of the arch of the foot. The convexity of the longitudinal arch is increased and the dorsal surface is correspondingly convexed.

According to Fisher, the term *talipes arcuatus* is applied to this raising of the arch of the foot, when the heel and the balls of the toes are in a horizontal plane. If the balls of the toes fall below the level of the heel, then, *talipes plantaris* is present. This will depend principally upon the length of the tendo Achillis, and should be considered as *talipes* equinus instead of plantaris.

Talipes cavus, is applied to any state of the foot in which the arch is increased. It may be either congenital or acquired. It may exist as a single deformity, or it may be associated with talipes equinus, talipes equino-varus or talipes calcaneus. Nearly every case of talipes equino-varus, has, associated with it, the cavus. The same causes that may exist to produce the talipes equinus, talipes equino-varus, or the talipes calcaneus, are exerted on the muscles which have their insertion in the sole of the foot, to produce the talipes cavus. Cases that are recovering from infantile paralysis, with deformity of the feet, invariably have talipes cavus.

Artificial talipes cavus, or calcaneo-cavus, is found in the deformed feet of Chinese women. The deformity is effected in early life—about the fifth year, by an ingenious method of foot-binding. According to Dr. Robert P. Harris, the foot is narrowed by bending the four small toes under the foot, and

the tarsal bones are forced together on the plantar surface and subjected to continuous pressure. Then the os calcis, and the astragalus, are forced downward until the heel is vertical and its bones are on a line with those of the leg.

Doubtless, shoes with high heels under the hollow of the foot, worn by some fashionable young ladies and dancing girls of this country, have a tendency to produce talipes cavus. This is especially true of the razor or needle-toed shoe, in which the toes are crowded, or are rolled under the sole of the foot.

Morbid Anatomy. The change in structure is chiefly in the shortening of the plantar fascia. In the great majority of cases, the bones are not much affected. The muscles in the sole are contracted, but not structurely shortened. In some cases, there is unnatural pressure upon the nerves, giving rise to " painful cavus," or tarsalgia. In severe cases, calluses and corns, which form at the points of pressure from walking, occasion great pain.

The diagnosis of talipes cavus is evident.

The prognosis is excellent in the congenital cases, and even in the long standing cases, the deformity may be relieved by appropriate measures.

Treatment. Relief from the milder forms of talipes cavus, may be accomplished by extension, with a talipes equinus shoe. Considerable relaxation of the plantar structures may be produced by soaking the foot in hot water, or by the use of electricity.

Division of the plantar fascia. The resisting cases demand operative interference for the purpose of lengthening the plantar structures. The tight bands may be easily felt by passing the edge of the finger nail across the sole, while the tissues are made tense by stretching the foot.

The point at which to enter the tenotome, is on the inside of the foot, one-third nearer the attachment to the os calcis, than to the roots of the toes. The assistant fixes the heel with one hand, and grasps the ball of the great toe with the other, relaxing the tissues, while the tenotome is introduced. The knife being inserted, is passed across the foot, close to

the skin, and turned with its cutting edge toward the bones. The assistant then makes the tissues tense, and, by a sawing motion the rigid bands of fascia are divided.

A practical point, is that after the division of the superficial bands, as the extension is made, deeper ones will come into prominence and necessitate wider section than at first seemed necessary. If any contracted fascia is present on the inner border of the foot, it can be relieved by a section made from the same skin puncture.

As the resisting bands are divided, the foot can be felt to give away towards a normal shape. In severe cases, moderate force may be used to assist in reducing the deformity.

The small wound is then dressed with gauze, and a plaster bandage applied, as suggested for talipes equino-varus.

If the patient suffers pain, on attempting to walk in one or two weeks after the operation, he should remain quiet for a longer time, or at least begin exercising very gradually. The pain is from unaccustomed pressure, and will pass away in time. Tubby says the less the foot is stretched, for the first fourteen days, the less will be the pain.

SECTION VIII.
AFFECTIONS OF THE TOES AND FINGERS.

CHAPTER I.

METATARSALGIA.

Definition—Etiology—Symptoms—Diagnosis—Prognosis—Treatment.

Metatarsalgia (Morton's disease) is a painful affection, chiefly situated in the anterior part of the foot. The pain is neuralgic in character, in some cases intensely acute, and in others it is a dull ache.

Etiology. The immediate cause is pressure on the nerves at the heads of the metatarsal bones. In some instances, it occurs after long standing and walking, especially while wearing narrow shoes.

The disease may follow some protracted illness, such as typhoid fever or rheumatism. A gouty or rheumatic diathesis may play an important role in the production of the disease.

Symptoms. The principal symptom is the pain complained of by the patient. Frequently it is intense and paroxysmal, and walking is prevented. The pain starts from the head of the third and fourth metatarsal bones and is reflected up the limb. In some cases the pain is increased by exercising, while in others it is greatest when the shoe is removed and the foot is at rest. The patient has a constant desire to remove the shoe and hold the front part of the foot firmly with the hand.

Deep tenderness can be elicited, about the heads of the third and fourth metatarsal bones. If careful comparison is made between the two feet, the diseased one is often found to be slightly wider across the ball of the foot. The arch may be raised slightly above the other, giving the foot a limited tendency toward talipes cavus.

Diagnosis. The symptoms and history in connection with an examination, should be carefully detailed. In so do-

ing a diagnosis can be made. Some cases might be mistaken for rheumatism, unless the symptom of each affection are kept well in mind. The pain accompanying flat-foot need not be mistaken for metatarsalgia, as in the former trouble, the observance of the deformity will make the diagnosis clear.

Prognosis. In all cases the prognosis should be guarded. Generally speaking the disease is a tedious one. Even under treatment and complete rest, the pain may be annoying for sometime.

Treatment. The acute attacks of pain can be relieved by soaking the foot in hot salt water. The pressure from a moderately snug bandage gives relief in some cases. The application of dressings, wet with some anodyne lotion, held in place by a snug bandage has been found to be beneficial.

In all cases where a cure is desired, complete rest from walking must be secured. In two or three weeks, the patient may be allowed to walk some, and the best boot that can be worn for this trouble, is one with a heavy sole. At the balls of the toes, the boot should be wide enough to allow the foot a natural amount of room.

In severe and long continued cases, which will not yield to ordinary treatment, Morton advises, the resection of the head of the fourth metatarsal bone. In these cases it is best to cut through the sole of the foot, to the head of the metatarsal bone, which seems to be most prominent and the most sensitive. The excision of the head of that bone will relieve the pressure from the nerve and after a time a complete cure will result.

CHAPTER II.

HALUX.

Halux Valgus—Definition — Etiology — Symptoms —Treatment — Preventive,
Operative ; Halux Varus—Definition.

Halux Valgus is an abduction of the great toe, and the
foot at its metatarso-phalangeal articulation is somewhat
widened. The principal feature in the deformity is the promi-
nence at the first metatarso-phalangeal articulation. The
bones at this joint become enlarged, and between them and
the skin is often an inflammed bursa, or bunion.

Halux valgus is due largely to the wearing of badly fitting
boots. It is not so often due to tight-fitting boots, as it is to
those which are too short or those which being narrow
pointed, crowd the great toe into the position of halux
valgus.

The observation of surgeons and anthropologists, shows
that in persons who go bare footed constantly, the great toe
and inner border of the foot form nearly a straight line. Halux
valgus is an acquired deformity, that arises from the wearing
of boots. It is exaggerated by the demands of fashion, or by
the carelessness of parents who do not see to it, that their
children wear shoes that admit of sufficient room for the
toes.

Symptoms. In most people, some displacement of the
great toe is present, but it is usually not enough to cause
pain. In halux valgus, it is the pain and soreness of the part
that the patient will complain of, and, when his tolerance be-
comes exhausted, he seeks the advise of the surgeon.

The history of long standing difficulty, the altered direc-
tion of the great toe, the presence of inflammation, and, per-
haps a fluctuating bunion with corns over the prominences of

the bones, mark the clinical picture.   Halux valgus is often
associated with talipes valgus.

The patient's gait is altered by the weak and sensitive
feet, and in severe and long standing cases, the suffering is
intense.   Cellulitis, suppuration and in some cases an osteitis
are distressing complications.

Fig. 193.   Double halux valgus and flat-foot.

Treatment. In selecting boots for cases of halux valgus,
or for any foot whether deformed or not, the physiological shape
of the foot must be kept in mind, and the shape of the boot
selected accordingly.   In these days, of needle-toed boots,
care must be taken that the toe of the boot is in nearly a
straight line with the inner border of the foot.   A boot thus
shaped and permitting of plenty of room for all the toes, with
the instep fitting snugly, is the proper one to select.

In cases of halux valgus, it is well to draw an outline of
the sole he should wear, so that it may be taken to the boot
maker, as an assistance in shaping the boot.

The sole of the boot, under the metatarso-phalangeal artic-
ulation, should be as broad as the sole of the foot, when the

Fig. 194.   Skiagraph of double halux valgus.

weight of the body is being borne upon it. If deformity or
sensitiveness be present at the bunion-joint, the upper leather
should be blocked out, so as to give ample room at that point;
all the lateral pressure on the foot should be borne posterior
to the metatarso-phalangeal articulation.

Boots worn that are fitted on this plan, together with
moulding the foot—pulling the great toe inward, night and

morning, will correct halux valgus in time. In some cases this plan has been supplemented by the wearing of a tape around the great toe, on the inside of the foot to the ankle, in such a way that it draws the toe inward.

When the bursa is large and painful, and subject to recurring attacks of inflammation, operative procedure becomes necessary.

Under anæsthesia a linear incision should be made and the bunion dissected out. If the joint should be prominent, the incision is carried to the bone and after the soft parts are pushed away with a periosteotome, bone forceps can be used to cut away the head of the first metatarsus, and the base of the first phalanx.

Under aseptic precaution, the wound heals readily and the toe assumes a natural position.

In mild cases the cure of sensitive bunions may be effected by the wearing of suitable boots, and the application of anodine lotions, or ointments. Hot boracic acid fomentations may be applied with benefit.

HALUX VARUS is a deformity where the great toe is diverted inward. This deformity is usually congenital and is most often met with as a complication of talipes equino-varus. The treatment consists of manipulations and the use of a splint, or a shoe to press the toe outwards.

CHAPTER III.

HAMMER TOE.

Definition—Complications—Etiology—Treatment—Preventive—Operative.

Hammer toe is a plantar flexion of one or more toes. It is usually the second, while the third toe rides over it and assists in further flexion. The places on the toes subjected to pressure and friction, from the boot, are usually rendered sensitive by the presence of corns.

The hammer toe may be either congenital or acquired; when congenital, the second toe is the one that is affected, and it usually exists in both feet.

In the acquired cases, hammer toe is often associated with halux valgus. As the displacement of the great toe persists, it rides over the second toe, and the third, fourth and fifth are crowded inward. In some cases, the fourth and fifth toes are flexed, giving the appearance of being rolled under the foot.

Acquired hammer toe is caused by wearing boots in which too great pressure is made on the toes. The same remarks already made in connection with the etiology of halux valgus will apply in hammer toe.

Treatment. In slight cases the same attention should be given to the proper fitting of the boots as in halux valgus. Moulding of the toes will assist, and it is well to have the patient wear some form of splint at night, that will retain the toes in a corrected position.

In cases of medium severity, some plan of operative treatment is necessary in order to correct the deformity. In some cases, the forcible reduction with the fingers, under an anæsthetic, may be successful.

In the more severe cases, the division of the flexor tendon

and the contracted fascia, is necessary. This is best done through a longitudinal incision on the under surface of the toe, near its base. All contracted tissue should be severed, so as to allow the toes to be freely extended. The wound is then closed, antiseptic dressing applied and the toes held in the corrected position by splints, or a plaster bandage.

At the time of the operation, the corns should receive such treatment, as is liable to hasten their cure while the patient is confined following the operation. The hypertrophied and hardened epidermal scales should be removed, and a soft dressing applied.

After the operation, when the patient is permitted to walk, the same attention as has already been detailed in regard to proper foot wear, must be persisted in, in order to prevent a recurrence of the deformity.

CHAPTER IV.

CONTRACTION OF THE FINGERS.

Definition—Etiology—Traumatic, Paralytic, Dupuytren's Contraction; Morbid Anatomy—Prognosis—Diagnosis—Treatment—Expectant, Operative.

Contraction of the fingers, is a prominent flexion of the fingers which is usually most marked at the second phalangeal articulation.

It may be either congenital or acquired. The congenital form is quite rare, but is seen occasionally, and when present, is frequently associated with congenital hammer toe. Generally, the flexion is limited to the little finger, but at times the ring finger, and even all the fingers may be contracted.

The acquired form is quite common. It is most often seen as a flexion of the ring and little fingers. The flexion varies, however. Sometimes the little finger shows the greatest contraction, and again the ring finger may present the most marked deformity, while occasionally the middle finger is most affected. In this, there is a variation according to the cause. Likewise the deformity may be present in one hand or in both.

Etiology. The congenital form is caused by an error in development. The acquired form is of three classes:

1. Contractions caused by local inflammation.
2. Contractions caused by paralytic affections.
3. Contractions caused by an affection of the palmar fascia. (Dupuytren's Contraction.)

1. Inflammation involving the bones, muscles, fascia or skin, frequently produces a permanent shortening of the soft parts, and a deformity of the fingers remains.

In burns, abscesses, lacerated and contused wounds, and sometimes fractures, where considerable tissue is involved in an inflammatory process, resulting in cicatrization, the fingers become permanently contracted.

Sometimes, after deep felons, where the tendon sheath has been widely opened, the tendon becomes contracted. Contraction of the flexor tendon occurs in cases where there has been a complete division of the extensors of the fingers.

2. In nearly every case of paralysis, where the upper extremity is involved a more or less prominent contraction of the fingers occurs, especially, when the patient is making a partial recovery from the paralysis. It is most noticeable in cases of infantile paralysis.

Other conditions of the nervous system, such as the spasms of tetanus, tetany or chorea, sometimes produce a mild form of finger contraction.

Fig. 195. Paralytic contraction of the hand and fingers.

Contraction from chronic rheumatic arthritis will not be considered here.

3. Dupuytren's contraction is a flexion of one or more fingers due to a contraction of the palmar fascia, and its digital prolongations. The deformity is one that comes on in middle or late life. The principal theories that have been advanced for the causation, are as follows:

    1. Traumatism, such as bruises received on the palms. (Dupuytren.)

    2. Gout and rheumatism. (Adams.)

    3. Syphilis. (Ricord, Ricket.)

    4. Nervous origin. (Abbe.)

    5. Bacterial origin. (Anderson.)

Until some of these can be substantiated, we must fall

back on the following as causal factors. In a patient whose neurotic condition arises from hereditary or acquired gout, slight causes are sufficient to start Dupuytren's contraction; and such causes are to be found in traumatisms, either single or frequently repeated. (Tubby.)

Morbid Anatomy. The morbid changes in cases resulting from local inflammation, will depend upon the character of the original disease.
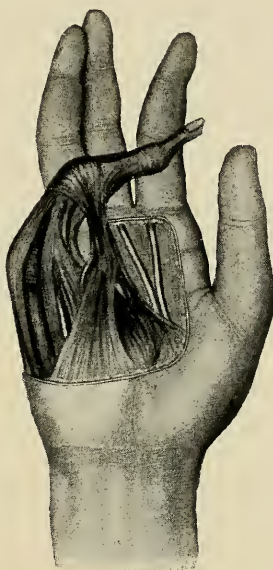
Fig. 196. Dissection of Dupuytren's contraction.

If the inflammation involves the bone and the sheath of the tendon, either in the hand or the forearm, the contraction may be due to the shortened tendon; while if there was an open wound that healed by granulation, the cicatricial contraction, would involve the skin and fascia as well.

In paralytic contraction, there is generally only a shortening of the flexor tendons. In any form of contraction, however, as time advances with the extremity in a flexed position, there is, at least, a tendency in all the soft parts to be adjusted to the length corresponding to which they are used. The bones do not, as a rule, become changed.

In Dupuytren's contraction, there is a general hyperplasia of one or more bands, followed by contraction. In some cases the deposits appear to be local, and to affect the fascia in the form of small fibromata. The skin, being united with the fascia, must accompany it in any change in length. The fat in the palm disappears, so that the fibromatous nodules may be plainly detected.

At first there is a slight deposit and only a feeling of tightness of the fingers. There is often considerable neuralgic pain. The affection may progress rapidly, or slowly. In some cases, the tip of the finger has been two years in being drawn down to touch the palm. (Adams.)

Prognosis. Inflammatory contractions usually remain. Paralytic contractions usually improve with the improvement of the paralysis. Dupuytren's contraction is usually progressive. In time, the fourth and fifth fingers become firmly flexed against the palm of the hand.

Diagnosis. A careful examination will usually determine the nature of the contraction. Inflammatory contraction, is evident from the scar and the history. The paralytic form, from the paralysis being present elsewhere. Dupuytren's contraction, from its location, and the presence of the fibromata.

They can be distinguished from rheumatic contractions by the evidence of rheumatic deposits in joints elsewhere than in the fingers.

Treatment. The expectant treatment should be followed in all cases at the beginning of the contraction. Many times, the deformity may be averted by careful attention and proper dressings at the beginning. This is especially true of contractions arising from inflammatory conditions.

In the treatment of all acute affections of the hands and forearm, the fingers should be kept in the extended position, particularly where there is a tendency toward contraction.

If the deformity is mild, a vigorous application of massage and electricity may be of great value in loosening adhesions and bringing the muscles into an active condition.

Congenital cases, if treated early, will generally yield to this plan of treatment. The same plan is of the greatest

value in all cases of paralytic contraction. It should be administered regularly and methodically, and followed up for a long time.

In Dupuytren's contraction, the plan is to use a mild means of treatment, such as massage, rubbing and splints, to keep the fingers straight as long as possible. The permanent contraction may be considerably delayed by this means. Where the affection is at all marked, mechanical extension, if used, will only be painful and unsuccessful. The
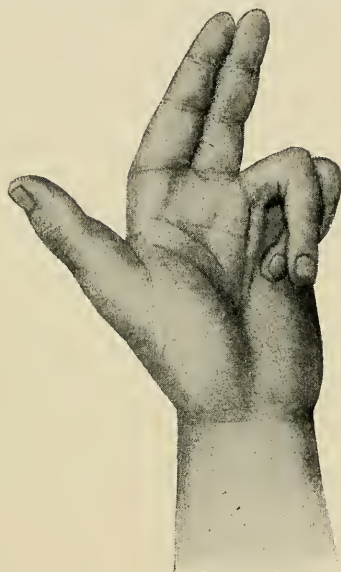
Fig. 197. Dupuytren's contraction of the fingers.

only available curative measure, is an operation upon the fascia.

Operative Treatment. When cases are of long standing, and the deformity is marked, operative treatment is the only effectual method of its reduction. This may be by either the subcutaneous or open method. The method to be chosen will depend somewhat upon the nature of the contraction.

Contractions containing scar tissue, which involve the skin and fascia, must be carefully lengthened by the open method. The same method of operating should be adopted,

where the contraction involves the flexors of the fingers. The plan to persue is that of tendon lengthening, instead of simple tendon division.

Tendon lengthening is performed by cutting and splitting the tendon, in such a way, that it may be lengthened and repaired, by suturing the fibers of the tendon and its sheath, leaving it of a sufficient length to allow extension. (See Sec. II, Chap. XIII.)

The point to be selected for the incision is usually the location for the cicatrix. Where the long flexors are involved, some preference is given to an incision above the annular ligament.

All adhesions should be carefully separated and the fingers extended, and, if possible, the wound should be closed, so as to secure union by first intention.

Subcutaneous tenotomy, performed by the writer on the flexors of the hands, has not been followed by the patient regaining normal usefulness of the fingers. Strict asepsis must be enforced in all these operations.

Dupuytren's contraction of the fingers, may be relieved by either the subcutaneous or open method. In the subcutaneous method, numerous punctures must be made, in order that the resisting fascia, with its digital prolongations, may be sufficiently divided to allow the deformity to be thoroughly corrected.

The first puncture, may be made in the palm a little above the transverse crease. The second puncture, should divide the same cord a little farther toward the fingers; the third and fourth to divide the lateral bands which pass to the fingers. In this way twenty or thirty punctures may need to be made. (Adams.)

It is best to use a sharp pointed tenotome, to make the punctures in the skin, and then to introduce a blunt pointed tenatome.

The nerves and arteries are to be avoided, as far as possible. In some cases the deformity cannot be reduced without tearing the skin. If the fascia, is well divided, the skin will lengthen by subsequent manipulations.

General anæsthesia is not necessary, as two or three drops of a two per cent solution of cocaine, injected into the skin at each point of puncture, will be all that is needed.

Many operators prefer an open incision. To this there is no objection, as it brings into plain view the structures needing division.

Dupuytren's method was to make two or three transverse incisions through the skin and fascia. Goyrand made a longitudinal incision over the drawn bands. Ricket modified the longitudinal incision by making a number of short transverse incisions at the end of the long one. Burch, dissected up a triangular flap with its base at the transverse crease.

It is not necessary to remove any of the tissue from the palm. When convenient, it is best to close the wounds in the skin by sutures. The hand should be dressed with the fingers comfortably extended. If the operation has been well done, there will be no trouble in gradually extending the fingers, even if at first the skin will not allow them to be straightened. No rough manipulation should be attempted. In a week or ten days, passive motion should be commenced, and be continued at times for some months. After such treatment, a relapse is not likely to occur.

SECTION IX.

HERNIA.

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GENERAL CONSIDERATION OF HERNIA.

Definition—Importance of the Subject—Frequency—Varieties—Etiology—
Predisposing Causes, Exciting Causes; The Hernial Sac.

By the term hernia is meant the protrusion of any viscus
from its proper cavity, through a congenital or an acquired
opening in the walls of the cavity.

The term must be qualified to denote the cavity involved
as we may have to deal with hernia cerebri, hernia testis,
hernia abdominalis, etc.

When the term hernia is used alone it is commonly un-
derstood to imply the protrusion of some organ from the ab-
dominal cavity. This may, therefore, be regarded as the con-
ventional use of the term.

Importance of the subject. Of all the surgical diseases to
which the human body is liable, there are none demanding a
larger share of anatomical knowledge, greater promptitude,
skill and dexterity in the performance of an operation, when
it is rendered necessary by a defeat of the lesser means em-
ployed for its reduction. Often the fate of a patient is decided
almost upon an instant, and a short delay may prove disas-
trous.

Frequency of Hernia. Hernia occurs much more frequently
than is commonly supposed. Malgaigne's estimate was that
one male in every thirteen had hernia, and one female in
every fifty-two. This estimate is perhaps a liberal one, but
it is not very far from the truth, both as to number and pro-
portionate frequency among the sexes.

The abdomen is particularly liable to hernia on account of
the movable state of its viscera, and of its natural openings for
the passage of blood vessels. Its apertures are often de-

ficient in structure and the omentum, mesentery, and bowels are subject to great changes in bulk.

Hernia may be either congenital or acquired. In the congenital variety the condition exists by virtue of developmental defects at birth. The contents of the hernia may not present in the sac until after birth, but the openings may be deficient in structure, so that the condition affords a ready means for the passage of the viscera.

The acquired variety is formed after birth and the visceral protrusion and sac appears simultaneously, at a time when there is increased pressure of the abdominal contents, either constant or intermittent.

Varieties of Abdominal Hernia. Herniæ are classified according to (1) their anatomical relations and (2) clinical conditions.

1. They are named from the apertures through which they pass. If the viscus protrudes through one or more of the inguinal rings, it is *inguinal hernia;* when it passes through the femoral canal it is *femoral hernia;* if it passes through the structures at the umbilicus, it is called *umbilical hernia.*

The following table will be of service in the study of classification:

HERNIA
- INGUINAL
  - Oblique or Indirect
    - Congenital.
    - Acquired.
  - Direct . . . Acquired.
- FEMORAL
- UMBILICAL
  - Congenital.
  - Acquired.
- VENTRAL.
- Ischiatic.
- Perineal.
- Pudendal.
- Vaginal.
- Diaphragmatic or Phrenic.
- Intra-abdominal.

2. The clinical nomenclature of hernia is couched in such terms as reducible, irreducible, incarcerated, inflamed strangulated and gangrenous.

Reducible hernia is one in which the contents of the sac can be returned within the abdomen.

Irreducible hernia is so named when it is not capable of being returned within the abdomen. A condition that may be due to its large size, or from the excessive development of fat, or from adhesions or adhesive bands.

Incarcerated hernia is one prevented from returning by a knuckle of bowel that is down and filled with feces. There are no severe symptoms, no cutting off of the circulation and it is not specially painful.

Inflamed hernia is one characterized by its being hot, red, swollen, and painful; a condition often the result of a badly fitting truss.

Strangulated hernia is one in which there is a constriction sufficient to cut off the blood supply of the hernial contents, and if relief is not afforded the parts soon become gangrenous.

The above conditions may be present in any of the herniæ named in the anatomical nomenclature. Other designating terms are used according to the kind of contents within the hernial sac.

If the hernia contains only intestines, it is called an *enterocele;* if it be omentum, it is *epiplocele* and if it be intestine and omentum, it is *entero-epiplocele.*

Other organs have been known to fill the sac, such as the kidney, the ovary, the appendix-vermiformis and the bladder.

A hernia may appear only within the inguinal canal or it may escape just outside the external ring. Some have named this condition *bubonocele;* if it passes into the scrotum it may be called *oscheocele* or *scrotal hernia.*

Etiology. It was originally supposed that the cause of hernia was due to a rent of the peritoneum or a portion of the abdominal wall, hence the term " rupture " was used as synonymous with hernia, but later it was demonstrated that the walls of the abdomen were not torn but only stretched, weakened and pouching.

The causes of hernia are undoubtedly both predisposing and exciting, and in most instances it can be shown that both these factors enter into the formation of hernia.

As a rule the protruding mass develops slowly, but at

times it may appear suddenly as the result of some exciting cause, exerted violently and directly upon the part.

The predisposing causes that contribute gradually to the weakening of the structures at the point of protrusion are:

1. Loose connection of viscera—the omentum, jejunum, ilium and colon are found loose in their connections and are free to move within the abdominal cavity.

2. Poorly developed natural apertures—These openings no doubt receive in certain cases a check in development, thus producing a state of weakness in structure.

3. Inheritance—It is well known that there are certain defects or certain anatomical peculiarities that run in families that are transmitted from parent to child. The apertures of the abdominal walls are liable to have these defects transmitted to the offspring.

4. Occupation is an important factor—heavy lifting, sudden and severe exertion, especially in a stooping posture; blowing on wind instruments, etc.

5. Habitual constipation, straining at stool, flatulent food, and violent coughing, are fruitful causes.

In early life perhaps the greatest number of cases are induced from predisposing causes, while in later life the greatest number are produced from exciting causes.

Sex has to do with certain kinds of hernia. Femoral hernia is more frequent in the female. The female is also more liable to umbilical hernia. Inguinal hernia is more frequently found in the male subject.

Other causes contribute more or less directly to the production of hernia, such as weakness of the muscular tissue of the abdominal walls. Surgical operations, such as laparotomy wounds, are fruitful sources of ventral hernia, especially those that are not firmly closed by adhesion and perfect coaptation.

The Hernial Sac. The hernial sac is a portion of the peritoneum that is pushed ahead of the visceral contents. This sac has a mouth, a neck and a fundus. The opening of the sac into the abdomen is the mouth; the narrow constriction below is the neck, and the bulging portion, is the fundus. The opening through the abdominal parieties is the ring.

The sac is formed by the intra-abdominal pressure. The abdominal wall gives way where it has the least external support, or at the weakest point; and as the pressure increases, the dilatation becomes greater, and the sac grows proportionately larger and its wall usually thicker. At first the sac is smooth and gliding—it slips back and forth in the canal, but later, as pressure increases it thickens, and often becomes adherent to adjacent structures which prevent its free return into the abdominal cavity.

The hernial sac is liable to the same irritation and inflammation as other portions of the peritoneum, and its adhesions may unite with its contents, though less frequently embracing these parts, than the walls upon the outside of the sac.

Of the different varities of hernia, there are four that are more common than the others. These are the inguinal, the femoral, the umbilical, and the ventral, and we shall, therefore, treat of these more particularly as typical of the rest.

CHAPTER II.

INGUINAL HERNIA.

Definition—Anatomical Arrangement—Acquired Oblique Inguinal Hernia—
Morbid Anatomy—Symptoms—Diagnosis—Inguinal Hernia in the Female
—Congenital Inguinal Hernia.

By the term inguinal hernia, we mean a protrusion of any of the contents of the abdomen through the whole or a part of the inguinal canal, which in several ways may be associated with the spermatic cord in the male in its course to the scrotum, or with the round ligament in the female.

Inguinal hernia is found more commonly in the male and comprises about eighty per cent of all cases of hernia.

There are several varieties:

1. *Indirect or oblique inguinal hernia.* In this case the viscus takes the course of the inguinal canal, entering the canal through the internal ring and following along the spermatic cord, making its exit through the external inguinal ring.

2. *Direct Inguinal hernia.* In this hernia the viscus does not enter the internal ring, but passes through the triangle of Hesselbach and from thence down and through the external inguinal ring.

3. *Congenital inguinal hernia.* This hernia is due to a failure of the funicular portion of the vaginal process of the peritoneum, which invests the testicle in its descent to obliterate the opening by adhesion of its walls. Thus an open channel is left between the peritoneal cavity and the tunica vaginalis.

Before a hernia is formed, unless in wounds, or deficiency of structure, a bag of peritoneum precedes the protruding viscera and forms the hernial sac. In recent cases the walls

of this sac may be quite thin, but they are usually thicker than the natural peritoneum, and in cases of long standing the sac walls become much thicker, due to the interstitial deposit in the membrane from pressure that is made upon it by the hernial contents.

If we examine the inner surface of the anterior wall of the abdomen, post mortem, where the arteries have been injected, we will observe two infundibulæ, or shallow depressions of the peritoneum.

Between these two depressions is a ridge running vertically, or nearly so. This ridge comprises the deep epigastric artery which is imbedded in the transversalis fascia. These two depressions are intimately concerned in the mechanism of inguinal hernia. If the viscus presses against the outer infundibulum, it will find its way through the internal inguinal ring which is situated in the outer depression and this will constitute oblique inguinal hernia.

If the hernial contents presses upon the inner depression it will push its way through the triangle of Hesselbach and will constitute the Direct Inguinal Hernia.

Beginning our observations, thus from within, and observing the vertical elevation which contains the deep epigastric artery, we obtain a perfect conception of these herniæ, and their relation to the epigastric artery, which is an important point in the study of the subject.

The deep epigastric artery takes its origin from the external iliac and passes behind, but across the course of the inguinal canal and close to the internal ring beneath, and from thence it runs obliquely upwards and inwards toward the umbilicus. It lies from one-fourth to one-half an inch to the inner side of the internal ring and from thence it passes up to the inner side of the rectus abdominalis muscle.

The external iliac artery and vein are directly behind the internal inguinal aperture, and this opening is the beginning of the inguinal canal in which the spermatic cord is continued through the canal down to the testis.

The spermatic cord quits the abdomen, through the internal ring, at a point midway between the anterior superior

spinous process and the symphysis pubis. The ring is formed
by two layers of the fascia transversalis. The anterior layer is
fixed in Poupart's ligament and the posterior layer descends
behind Poupart's ligament and forms a covering for the femoral
artery and vein and assists in the formation of the crural
sheath.

Fig. 198. Indirect or oblique inguinal hernia.

Above the passage of the spermatic cord, the two planes
of transversalis fascia meet and form a lining to the muscle of
the same name, and then run upwards as far as the dia-
phragm. As the cord penetrates these two planes that form

the internal ring, a thin layer of fascia unites the cord to the edges of the ring.

The inguinal canal in the adult is normally about two inches in length. In a hernia of long standing its weight and pressure causes the pillars of the internal ring to sag and hence the canal becomes much shortened.

The inguinal canal is bounded posteriorly by the fascia transversalis, above by the edges of the transversalis and internal oblique muscles; anteriorly by the tendinous portion of the external oblique muscle and superficial fascia, and below by Poupart's ligament. The external ring is formed by two columns of the tendon of the external oblique muscle, united with fibers from Poupart's ligament. The upper column is inserted into the symphysis pubis, and the lower column into the tuberosity of the os pubis. The pubes bounds the opening below, and from the edges of the ring, as well as from the surface of the tendon of the external oblique muscle, a thin fascia descends uniting the cord to the ring, and then passes down upon the cord to the tunica vaginalis.

The cremaster muscle arises within the inguinal canal from the internal oblique muscle and descends with the spermatic cord, passes through the external ring and spreads over the fore and lateral parts of the cord as far as the tunica vaginalis, into which it is inserted.

The spermatic cord passes down behind the cremaster muscle and the spermatic artery and vein, the vas deferens and its artery, and the absorbents and nerves.

We have now described the normal condition of the inguinal canal, and with a knowledge of this we are prepared to understand the varities of inguinal hernia.

Acquired Oblique Inguinal Hernia.

This hernia may be an enterocele, an epiplocele or entero-epiplocele, and it may be in the condition of a reducible, irreducible, incarcerated or strangulated hernia. It is the most frequent of all hernias and hence typical.

Morbid Anatomy. The acquired oblique inguinal hernia

involves not only the tissues of the groin above Poupart's ligament, but is liable to fall into the scrotum. Whatever viscus of the abdominal cavity is inclined to protrude, it first presents in the external infundbulum and enters the internal inguinal ring. Surrounded with the peritoneal covering which forms the sac, it pushes its way through that opening at a point midway between the symphysis pubis and the anterior superior spinous process of the ilium.

As a general thing it throws the spermatic cord behind it, and the deep epigastric artery lies beneath the protruding mass and to the inner side.

The protrusion now pushes the tendon of the external oblique muscle, which forms the roof of the inguinal canal, and the tumor-like bulging becomes apparent. The edges of the internal oblique and transversalis muscles, the cremaster muscle, as well as the superficial fascia and skin also form a part of the covering. Poupart's ligament lies directly below and the transversalis muscle is situated behind the hernia.

Descending through the inguinal canal it next emerges at the external ring, where on account of lesser resistance it becomes more bulging and still resting on the front of the cord, it is apt to descend into the scrotum. The cremaster muscle may catch it at this point and hold it as it were in a basket.

Should a dissection now be made, there will be found the following structures:

Cutting below the external ring, from without inward, we pass through (1) the skin; (2) the subcutaneous or superficial fascia; (3) the fascia of the spermatic cord, derived from the tendon of the external oblique muscle. This structure is dense and forms a strong covering which has often been mistaken for the hernial sac; (4) the cremaster muscle; (5) the infundibular fascia, which comes originally from the abdominal cavity and is pushed ahead of the hernia; (6) the transversalis fascia. The next structure is the hernial sac.

These structures being very thin and some of them almost imperceptible, it may appear unnecessary to thus number and identify, them but it is the only way to become familiar with

the structure and relationship of things essential to a successful operation, should this become necessary.

There is much difference in the size of an oblique inguinal hernia. When it is situated within the canal it may be quite small, but when it escapes into the scrotum it may become so large as to reach the knees. Generally it does not exceed
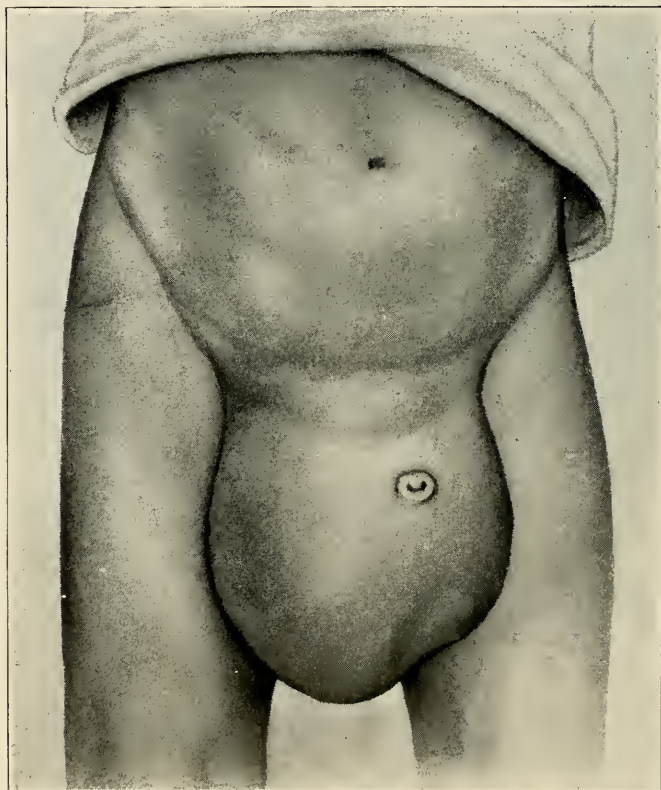
Fig. 199.   Large double oblique inguinal hernia.

the size of the fist. Its bulk depends considerably on the time it has existed, and upon the degree of relaxation and the attention of the patient.

Symptoms, At the outset, pain is usually felt prior to any protrusion. This is the case where there has been some act of violence. In some cases of intra-abdominal pressure un-

accompanied with any known act or injury. The bulging at the internal ring may be the first thing observed. If there is pain, it may not be felt at the seat of the protrusion, but it often radiates from the umbilicus, and is of a dragging, tearing, and colicky character. The pain is aggravated by straining at stool, coughing, heavy lifting or long standing upon the feet.

The swelling is best seen when the patient stands erect, and by placing the hand upon it and the patient being directed to cough, a perceptible impulse may be felt. If the patient lies down, slight pressure upon the tumor will cause it to retract into the abdominal cavity, if reducible. The skin of the scrotum may be invaginated over the tip of the finger, and thrusting the finger well up into the canal through the external ring, a perceptible impulse may be felt when the patient coughs. This is an important method where doubt exists as to the proper diagnosis.

Flatus may often be detected when the protrusion is intestinal; the intestines retire with a gurgling noise. If the contents are omental, there is a doughy feel and it is much less elastic, and it retires more slowly into the abdomen. Omental hernia rarely produces any disturbance of the abdominal functions when in a reducible state. The intestinal protrusion is often attended with constipation and with pain across the abdomen. A protrusion of the bladder is distinguished by the diminution of the swelling during evacuation of the urine.

Diagnosis. Inguinal hernia is not unfrequently confounded with varicocele. Varicocele is a very common complaint. It occurs most frequently on the left side and sometimes it receives an impulse upon coughing. It appears in the erect position and retires when the patient is recumbent. It is distinguished from hernia by its feel—having the feel of cords or worms in a sac. It is unattended with intestinal obstruction. By placing the patient on his back and emptying the veins, then pressing the fingers upon the external ring to prevent visceral descent, the free return of blood, which has receded, will again reappear if it is varicocele.

Hernia is sometimes confounded with hydrocele. Hy-

drocele begins below and as it develops, it becomes pyriform. The history of hernia is that it was first seen above at the inguinal rings. Hydrocele presents translucency if a bright light is placed on one side of the scrotum and one looks through from the other side. This is a good test, but it may sometimes fail to elicit the proper evidence, as the tunics are at times thickened.

Fluctuation may sometimes be of service though the fluid accumulation keeps the tunic tense. Hydrocele of the cord is distinguished with difficulty. Its transparency, its fluctuation, its shape and history are to be relied upon. The hypodermic needle may be used to test the presence of the fluid.

Hernia is easily distinguished from hæmatocele by the latter being a blood clot and accompanied at first by ecchymosis; by its not returning into the abdomen, and not necessarily occupying the inguinal canal, and being usually in the pendulous scrotum. It is round, and can be weighed in the hand, when it is found to be heavy, differing in this respect from a hernial tumor.

A hernia is also easily distinguished from a diseased testicle or an enlarged epididymis, with which it may sometimes be complicated. In such cases the hernial protrusion can be detected by its gliding movement upon manipulation or a gurgling sound may be made by the intestinal gases, and by a cylindrical enlargement that passes up through the canal.

It is sometimes a most difficult problem to tell whether it be an oblique inguinal hernia, or direct. Indeed this may be impossible. The protrusion of a direct hernia projects more abruptly than the regular oblique hernia and its outlines are more spherical; the canal is short and straight, and it looks rather outward toward the anterior superior spine of the ilium; the finger tips can push it back and it passes suddenly into the abdominal cavity. In old cases of oblique hernia, the inner ring is apt to become depressed by the pressure of the hernia until in some cases the internal ring becomes almost parallel with the columns of the outer ring, hence there is difficulty in diagnosis. For an understanding of these conditions we will now consider direct inguinal hernia

Direct inguinal hernia. This variety of inguinal hernia leaves the abdominal cavity at a point nearer the pubes than the former hernia, and not through the internal inguinal ring. The viscus protrudes from the inner infundibulum, the description of which is given in our chapter on the general subject of inguinal hernia. The protrusion is made through the triangle of Hesselbach, and thus pushes the epigastric artery to the outer side, instead of to the inside as in oblique hernia. Whatever the contents may be, it carries before it the peritoneum which forms the sac, and the transversalis fascia, as in the oblique variety. The hernia next pushes before it the conjoined tendon of the internal oblique and transversalis muscles and presents itself at the external ring through which it passes. It now secures additional coverings—the superficial fascia and skin, and lies above and to the outer side of the spermatic cord.

Direct inguinal hernia differs from the oblique in not taking the course of the inguinal canal—simply protruding directly through the external ring; having the epigastric artery to the outer side, and in having a more imperfect covering from the cremaster muscle, and a more perfect one from the transversalis fascia and tendon of the transversalis muscle. Its relation to the spermatic cord is also different. The spermatic cord in direct hernia is on the outer and upper part, while in the oblique, it lies behind and on the inner side.

Direct inguinal hernia may be produced suddenly by a laceration of the tendon of the transversalis muscle, in which case the covering of this tendon will be found wanting.

Direct inguinal hernia is not so frequent as the oblique, but occurs usually in strong muscular men whose tissues have been torn during some violent muscular effort. The sudden development of the hernia with the unyielding character of the tissues are quite apt to produce strangulation, and in this respect it becomes more dangerous than the oblique, but every hernia, whether oblique or direct, whether inguinal or femoral, ventral or umbilical is apt to develop characteristics which are distinct. It is vastly more important to determine whether the hernia is reducible or irreducible, obstructed or strangulated, than it is to know the special form.

Inguinal hernia of the female. The inguinal canal of the female is very much the same as that of the male, only the round ligament in the female takes the place of the spermatic cord in the male.

The round ligament arises from the fundus of the uterus and passes to the outer side of the epigastric artery, thence through the internal ring and down through the canal and external ring, taking its course obliquely downwards and inwards it is lost upon the abdominal wall near the symphysis pubis. In the female the canal is called the Canal of Nuck.

It is seldom that an inguinal hernia is found in the female, though occasionally it does occur and may be easily mistaken for a femoral hernia.

As the round ligament is not subject to the same affections as the spermatic cord, this hernia of the female is not so liable to be confounded with other diseases, although female inguinal hernia may be reducible, or may become inflamed, irreducible, incarcerated or strangulated as in the male subject.

Congenital inguinal hernia. This character of hernia originates from some defect in the normal descent of the testicle in the fœtus. The testicle is originally developed in the lumbar region and is invested by a fold of peritoneum—the mesorchium, which descends with it as it slowly makes its way to the scrotum, and ultimately forms a part of the tunica vaginalis.

This envelop is at first, part of the peritoneal sac and at birth usually separates from the peritoneum by the adhesion of its walls and of the funicular process which connects the tunic with the general peritoneal cavity.

The testicle which up to that time is found in the loins quits the abdominal cavity about the seventh month of gestation. At this time a strong ligament, called the gubernaculum testis is found connected with the inferior part of the testis and passing to the scrotum through the inguinal canal, appears to guide the testicle into its natural seat in the scrotum. The testicle is usually found in the scrotum at the ninth month, but there is considerable difference as to the period when the descent is complete. Sometimes it is earlier and sometimes

later; sometimes one testicle arrives and the other may be delayed or even permanently retained. When the testicle has reached the scrotum, the opening through which it has descended generally closes. This is the physiological process, but the time when this act takes place may vary and be prolonged until after the birth of the child. If the funicular portion of the vaginal process of the peritoneum, which is attached to

Fig. 200. Congenital inguinal hernia on the right side.

the testicle and invests it, is not obliterated by the adhesion of its walls, there is an open channel and a direct communication between the abdominal cavity and the tunica vaginalis. Thus there is nothing to prevent the protrusion of the abdominal contents from entering the canal and scrotum. It is plain that the protruding parts will have no proper peritoneal sac such as is seen in the common inguinal hernia. The viscus

in congenital inguinal hernia will be contained directly in the tunica vaginalis. It is not an uncommon thing for a defect of this kind to be present to a lesser or greater degree in adult life; the funicular process having remained·patent, but without the development of hernia at birth, but later when some exciting cause is added to the defect the hernia is produced. The closure of this canal is quite irregular; it may begin near the testicle and the viscus may enter the canal when only partly obliterated below; thus the testicle may be in part separated from the protruding mass. If the closure begins at the internal ring and the parts remain open below, a hydrocele of the cord may be established, or the hernia then with a separate sac may push its way down the canal invaginating the funicular process and there may be what Sir Astley Cooper has designated as the " encysted hernia."

The testicle is sometimes caught in its passage to the scrotum and may be retained—a condition that should always be recognized, as a truss placed upon it by mistake, would give great suffering and be at the risk of injuring the gland.

Female children may also have congenital inguinal hernia, but it is not so common as in the male and in such cases the protrusion takes the course of the unobliterated canal of Nuck.

CHAPTER III.

TREATMENT OF INGUINAL HERNIA.

The use of Trusses—Injection Treatment—Operations for the Radical Cure—
Bassini's Method, Halsted's Method, Kocher's Method, M. Dupley's
Method—Treatment of Irreducible, Inflamed and Incarcerated Hernia.

The treatment of reducible hernia may be either mechanical or operative. The mechanical treatment may, in certain cases, and under certain conditions, result in a cure; the operative has for its object the radical cure.

The Use of Trusses. In order to place a patient in a state of safety, and to prevent a future descent, a well-fitting truss is to be applied. A truss is necessary for the smallest hernia, as the danger of increase in size and of strangulation, is in an inverse ratio to the size of the protrusion.

The adjustment of a truss requires skill and a careful judgment. The object of a truss is to maintain uniform and constant pressure, and the pressure must be at the right point or it will do no good. This object before us it will be unnecessary to mention any special manufacture. If we have to deal with a reducible oblique inguinal hernia, the truss must be placed over the *internal* ring and from thence it may press upon the canal. The intestine or whatever protrusion there is must be placed first within the abdominal cavity. A recumbent position is here necessary. Some, unlearned, have placed the truss over the point of greatest bulging, which is below the external ring. If the truss is brought so low as to admit of the hernial contents entering the internal ring, the patient will suffer pain from the pressure of the pad upon the protruding part and there is constant danger of strangulation.

A patient often inquires, "will a truss cure me?" The

answer to this is, yes, if he be young or if the hernia is recent or is not very large. If a person has a hernia he should keep it within the abdomen and never allow it to come down. The pressure of a truss should not be beyond toleration and it should be worn day and night.

In the case of an infant a hernia should not be allowed to remain down. If kept back it will recover permanently in all probability. A truss should be secured, suitable to the age of the child. Sometimes a truss can be improvised from a skein of yarn or worsted that will answer for an infant. A number of these can be kept so that they may be changed when soiled.

In consequence of wearing a truss the sac gradually contracts and finally will prevent the viscus from protruding. To discard the truss before a cure is complete is very dangerous, for there is liability to strangulation. The principle upon which the pad of a truss is based, is to press upon the inner ring and the whole length of the canal. To obtain a truss it is necessary to take the measurement of the pelvis in order to have one the proper size.

The shut sac of a hernia will sometimes produce hydrocele by secretion from its inner surface. If the truss is worn long enough to contract and obliterate the opening, and a hydrocele remains, a mere tapping to let out the fluid usually is all that is necessary to cure the hydrocele. There is a tendency upon the part of nature to obliterate the sac in young subjects. This fact favors the surgeon's effort if he simply retains the hernia. The curative influence of a truss, does not lie in the strength of the spring and the consequent inflammation it is apt to excite, but it is most effectual when it is dilligently used as a rententive agent. Hence we do not suggest that pressure be carried to the extent of causing inflammation and pain. The cutaneous surface is the first to receive irritation. If adhesion of the rings and canal is promoted by the irritation from pressure of a truss, it would be after much agony to the patient.

Injection Treatment. Some surgeons who treat hernia with the view of promoting adhesion of the walls of the inguinal

canal, have resorted to injections. Some of these injections are made within the sac and some only within the canal. Velpeau demonstrated the possibility of obtaining a radical cure by iodine injections within the hernial sac. Others following Velpeau injected only within the canal. Pancoast sought to carry out the method of injecting before the classes of the Philadelphia hospital, but unfortunately there were too many failures. Heaton after many years of experience, informed us that he had discovered a means of exciting a mild grade of inflammation within the canal and he called his method " tendinous irritation." His method was to place his astringent and irritant in contact with the exterior of the neck of the sac, producing thickening and consolidation of the tissues, and effecting contraction of the openings. He insisted on returning the sac and throwing the injection within the canal only.

The fluid he used was the fluid extract of quercus alba prepared in vacuo, and alcoholic extract of quercus about fifteen grains; add to this morphia sulphate a half grain. He first reduced the hernia ,and the sac also. Pressing the spermatic cord out of the way by his special syringe, he pushed the nozzle through the skin and beneath the external pillar, and thus entering the canal at once, he distributed about ten drops of the above liquid, sweeping it around upon the walls of the canal and as far up as the internal ring. A bandage or pad was now applied and was not to be removed for six or eight weeks.

Joseph H. Warren advocated a similar method, using the fluid extract of white oak bark, reduced to a syrup, diluted with alcohol, to which is added sulphuric ether and morphia. Warren has also an improved syringe, the needle of which revolves and sprays the parts.

No injection must enter the abdominal cavity. Rest is enjoined until the reaction is over; a truss is then worn for a time, since the slight adhesions would yield to the pressure.

It cannot be said that these experiments have been quite satisfactory, as we have known too many failures to ensue within our own experience, and the statistical reports have a

very large per cent of failure. We are inclined to the belief
that in young subjects where the hernia is not too large or
too far advanced, the injection method, combined with the
wearing of the truss as above directed, may be of service, in-
asmuch as it is disposed to excite an adhesive inflammation
of the walls of the inguinal canal, but in old subjects it is not
only a failure, but dangerous. The whole proceeding in my
opinion is unscientific and does not reach the principles in-
volved necessary to a cure.

H. S. Tucker (Chicago Medical Times Vol. XXIX, No.
IX) has given some formulæ which he has used. He says
" bear in mind that a fluid to be injected into the tissues
for this purpose must be antiseptic and slightly astringent.

The following are among the best: Kennedy's white
pinus canadensis, two drachms; colorless hydrastis, two
drachms; alcohol two drams, glycerine two drams, carbolic
acid (ninety-five per cent.), fifteen drops; mix.

Bi-sulphate of quinine, forty-eight grains; boracic acid,
twenty grains; distilled water, one ounce; mix.

Distilled extract of hamamelis, three drams; colorless hy-
drastis, one dram; alcohol, two drams; glycerine, two drams;
carbolic acid, fifteen drops; mix.

Kennedy's dark pinus canadensis, reduced by evapora-
tion one-third, four drams; carbolic acid, forty-five drops;
glycerine, twelve drams; mix.

All the above formulæ are good, and the quantity to be
injected at one treatment is from five to fifteen drops. The
injection is not attended with much pain. The needles used
are of different sizes fitted to an ordinary hypodermic syr-
inge. The patient is given a small dose, and allowed to
attend to business, the injections being repeated at intervals
of from four to seven days until a cure is effected. Cases
treated by this method must first be fitted with a truss,
which retains the rupture perfectly. It is not necessary to
inject the fluid into the canal every time the patient receives
a treatment, but if it is injected into the tissues around the
rings it excites a low grade of inflammation, with a prolifera-
tion of cells, causing adhesion of the connective tissue, and
of the membranous lining of the canal."

The Radical Cure of Hernia. The earlier operations for the radical cure of hernia have all been replaced by the modern methods. The recent operations promise better results and they are all carried out after thorough exposure of the field of operation by careful dissection. It is now conceded that whatever operation is performed the following points must be maintained:

1. Thorough asepsis. In no department of surgery has this principle proven itself of greater necessity and its results in hernial operations have been most satisfactory.

2. There must be a dissection of the whole field of operation; the inguinal canal and rings are to be exposed. It is not how little may be cut but how much, and enough is done to give perfect freedom in attacking the parts necessary for the cure.

3. The hernial sac must be dealt with in one or the other of the modern methods, as (a) ligation of the sac and extirpation (Socin); (b) ligation of the sac and suture of the canal (Czerny, Barker, Banks, Championiere, McCormac); (d) infolding of the sac and suture of canal (Macewen); (e) torsion of the sac and suture of the sac in the canal (Ball); (f) torsion of the sac and suture of canal with the sac external to the aponeurosis of the external oblique (Kocher); (g) high ligation of the sac; and suture of canal after displacement of the cord (Bassini, Marcy, Halsted); (h) splitting of the sac, braiding and tying the split parts into knots returning into the abdomen and reinforcement of the internal ring (M. Dupley, surgeon to Hotel Dieu, Paris).

4. The reinforcement of the internal ring has become an essential part of the operations.

5. There must finally be a restoration of the divided layers of the abdominal wall with closure of the canal and with provision of a channel for the spermatic cord.

At the present time there are but two or three methods that becomes necessary to pass here in review, and in so doing the advantages and objections to other methods not reviewed will be shown.

Bassini's Operation. 1. The external incision begins at a

point nearly on a level with the anterior superior spine and
runs downwards and inwards about half an inch internal to
Poupart's ligament ending about the centre of the external
ring.

The writers method of making this incision is to pick up
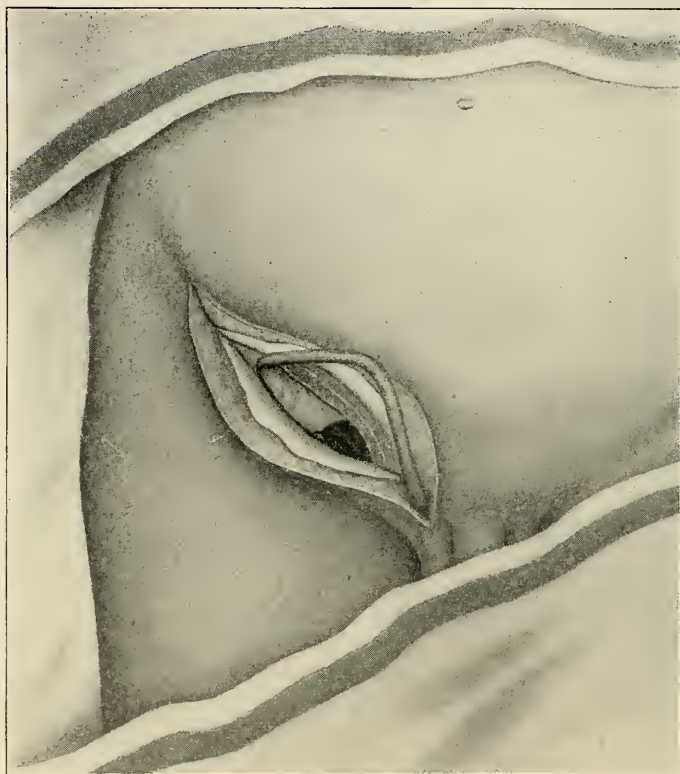
Fig. 201. Bassini's operation for inguinal hernia. The dissection through
   skin, subcutaneous fatty tissue, aponeurosis of the external oblique which
   is rolled out; the spermatic cord is lifted, showing the muscles and fascia
   beneath.

a fold of the skin transversely to the canal one end of the fold
to be held by an assistant, the other by the left hand of the
operator, and with a narrow bladed bistoury the fold is trans-
fixed on a line as indicated in Bassini's incision, with the
edge looking upward and with a slight sawing motion the
incision is made with a single sweep. The advantage of this

method is apparent, the field is cleared down to the superficial fascia and the vessels lie beneath.

2. The incision is rapidly carried down to the aponeurosis of the external oblique, which is then exposed for a distance of two and a half to three inches. A director is now
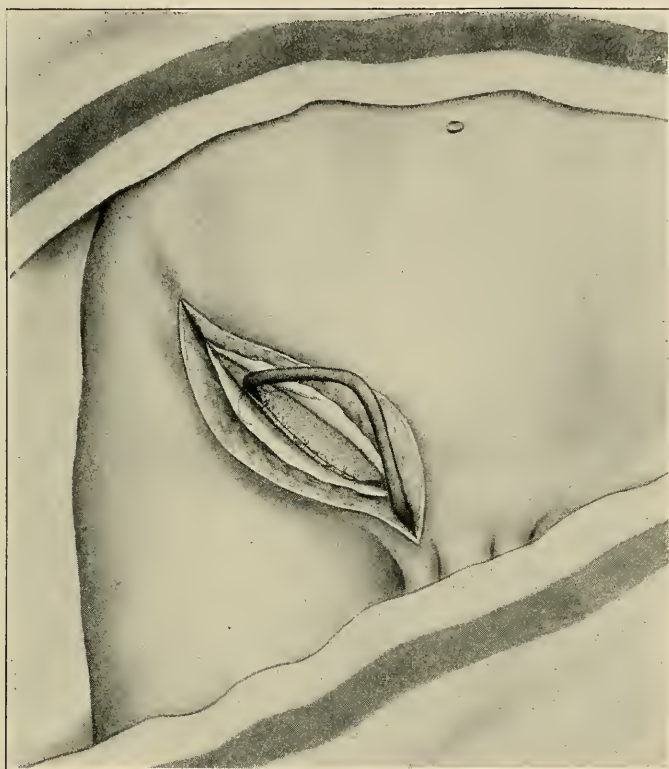
Fig. 202. Showing deep sutures in Bassini's operation. They include the internal oblique and transversalis muscles, and transversalis fascia on one side and the shelving edge of Poupart's ligament on the other.

passed beneath the external pillar of the ring and up beneath the aponeurosis into the canal, and the aponeurosis is divided to one inch above the internal ring.

3. The cut edges of the aponeurosis are now held up with forceps and dissected free from the underlying muscles as far as the edge of the rectus, internally, and externally

until the shelving portion of Poupart's ligament has been clearly defined.

4. The sac and cord are now isolated, and this is best done with fingers and blunt pointed scissors. If the peritoneal layer of the sac is first reached the dissection is easy, rapid and bloodless.

5. Now the cord and its vessels are carefully separated from the sac with the fingers, and the separation is carried high up to within the internal ring; the sac is opened and its contents examined. If there are adhesions they are separated; if there is thickened omentum it is excised and the sac is ligated or sutured above the internal ring where it merges into the general peritoneal cavity.

6. The cord is held up and the edges of the aponeurosis rolled back, and from four to six buried sutures are introduced beneath the cord. These are best introduced from within outward, and should include the internal oblique and transversalis muscles, the transversalis fascia, and sometimes the edge of the rectus and the deep shelving part of Poupart's ligament on the other side. The lower suture should embrace the conjoined tendon.

7. The cord is now replaced and the cut aponeurosis is closed over it by continuous suture.

8. The skin wound is closed with interrupted sutures without drainage. This completes the operation.

In Bassini's method the omentum if taken away is ligated with catgut, and it is advisable to use the transfixion method. The sac is separated from other fibres with dull dissection, carried well up within the abdominal cavity; a moderate amount of traction is used by a series of artery forceps held by assistants, and the sac is ligated with cat-gut and transfixed.

The cut edges of the aponeurosis of the external oblique are well retracted, and the cord is held out of the field by a blunt hook, or by the fingers of an assistant, and the transversalis and internal oblique muscles on the upper side are united to the shelving edge of Poupart's ligament by a series of interrupted sutures of chromatized catgut or kangaroo-tendon sutures. Bassini prefers silk sutures. The needle

should not enter Poupart's ligament more than a quarter of an inch from the edge. From four to six sutures are used and care exercised not to constrict the cord; the first two sutures close to the pubis should include the border of the rectus muscle.
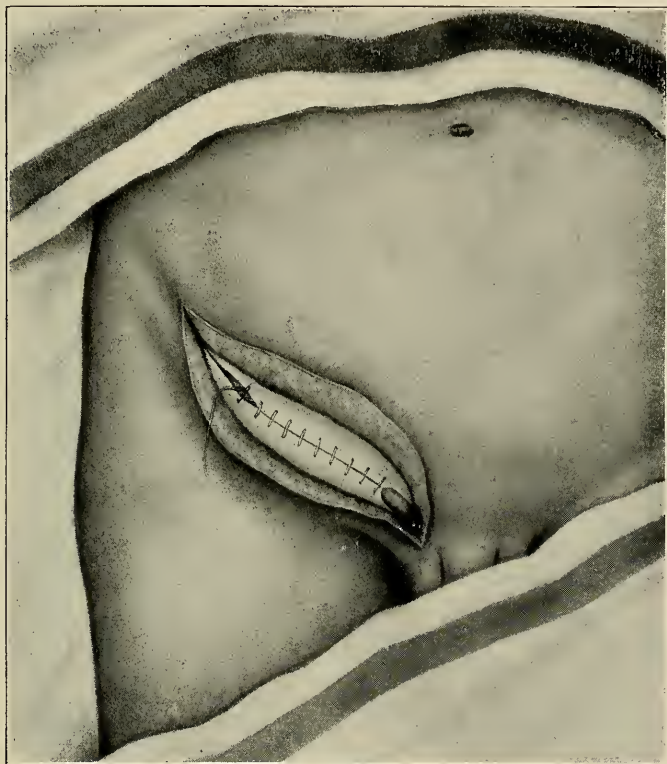
Fig. 203. Showing suture in the aponeurosis of the external oblique, closing it over the spermatic cord after Bassini's method.

The anterior wall of the canal is closed by suturing the divided external oblique aponeurosis. Chromatized catgut may be used here. Bassini uses silk.

The skin wound is now closed, and if thoroughly aseptic, no drainage is needed.

An antiseptic dusting powder—iodoform, or boracic acid, may be applied, a large compress of sublimate gauze placed

over the parts and a pad of absorbent cotton, then rubber
tissue, all secured with a spica bandage. When thorough
asepsis has been secured, and aminal sutures have been
employed, the wound should heal under the first dressing.
Perhaps two or three weeks in bed is the average duration.
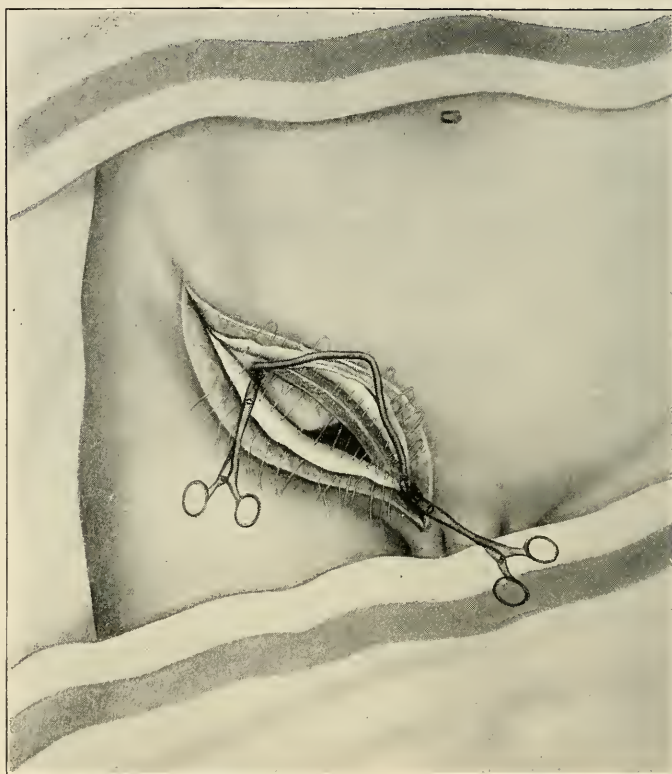
Fig. 204. Modification of Halsted's operation. The dissection made as in
Bassini's operation and in addition the cord is diminished in size by the
removal of the veins. Showing sutures inserted.

No truss is advised, but we are inclined to support the parts
with pads of gauze and absorbent cotton secured with a
spica bandage for a time after the patient is on his feet.

Halsted's Method.—The method of Halsted is similar to
that of Bassini, and will require but little comment here.
The principal difference is in the manner of dealing with

the spermatic cord. Halsted lifts the spermatic cord out
of its bed permanently and makes a new posterior wall out of
the aponeurosis of the external oblique. He thus seeks to
strengthen the floor and deeper ring. He trims the cord of its
superfluous dilated veins and thus lessens its bulk. The
cord lies only beneath the skin and emerges through the

Fig. 205. Showing the sutures tied, closing the canal beneath the spermatic
cord. The cord penetrating the muscles at the upper angle of the wound.

abdominal muscles about an inch to the inner side of the an-
terior superior spine of the ilium.

The skin is united by very fine silk sutures, which,
when tightened are buried. They are taken from the under
side of the skin and include only the deep layer which is
not occupied by sebacious follicles, thus avoiding suppuration.

While Bassini has three rows of sutures Halsted has but two.

The first course of stitches embraces all the structures excepting the skin.

The incision is made far toward the anterior superior

Fig. 206. Showing Halsted's operation nearly completed. The fascia and skin closed over the cord with interrupted or burried sutures.

spine of the ilium in order to have a muscular bed for the cord, which is laid to the outer edge of the inner ring and made to pass down well to the outer edge of the field.

Kocher's Method.—Kocher's method is somewhat ingenious. The skin and superficial fascia are divided over the inguinal canal, and laterally outward in the direction of Poupart's ligament. The cord and hernial sac are exposed at

the external ring. The hernial sac is recognized, and isolated from the cord and drawn down until the neck of the sac is exposed. The sac is now opened and the index finger of the left hand is introduced into the canal, and a small opening is made through the aponeurosis of the external oblique. A slender pair of forceps is now passed through the opening and through the lower muscular fibres of the internal oblique and transversalis muscles, and the forceps is withdrawn through the inguinal canal and finally out of the superficial opening. With the same instrument the isolated sac is grasped and drawn through the canal, and through the narrow opening in the anterior wall that is lateral to the direction from the upper end. The hernial sac now hangs through a narrow opening above Poupart's ligament. It is now twisted energetically, and is then laid over the outer surface of the aponeurosis of the external oblique muscle, and against the external ring and in the direction of the canal. By this tension and bulk, pressure is made on the canal and acts as a compression. The parts are now fixed in this twisted position by means of deep stitches passed above the twisted sac, through the fibres of the external oblique tendon, and the underlying fibres of the internal oblique and transversalis, through the sac and then made to embrace Poupart's ligament, care being taken not to sew into the external iliac vessels or spermatic cord.

Duplay's Method.—Having performed this operation, with perhaps slight modification, I feel inclined to mention it here. The incision down to the hernial sac is made similar to that of Bassini, and the field is cleared by severing the aponeurosis of the roof of the canal. The incision is cleared to half an inch above the internal ring. The cord and sac are separated and isolated, the sac is now opened and drawn down. It is then split into from four to six pieces; the tails or split pieces are tied into a knot by the aid of the hemostatic forceps, after which the end may be again split and each tail piece tied again. All the strips are thus treated and then secured by passing a catgut suture through the knots to prevent slipping. The knots may now be secured to each

other and the ends if redundant may be snipped away. These are now pushed up above and within the internal ring. The writer's modification is to suture the stumps to the columns of the rings. The ring is to be closed and reinforced, suturing it with chomatized catgut, and leaving it sufficiently open so as not to crowd tightly upon the spermatic cord, which is pushed to the outer side. The incision is then closed in a manner similar to that of the operation of Bassini.

It is believed that the principal elements of success in all operations for hernia, are thorough asepsis and a perfect reinforcement of the internal ring. In some cases Bassini's method may not give the advantage in this regard, and a resort to Halsted's method in taking care of the aponeuroses would be preferred. From our personal experience we are partial to dealing with the sac after Duplay's method. In small hernias, this might not be quite practicable, owing to the shortness of the sac.

The most successful method of dealing with hernia is to study well the best methods and then to select such elements from each as will be dictated in each individual case. We are not inclined, therefore, to adopt a single author, but to select from each one who has gained renown in such points as promise the best results.

Kocher's method is sometimes used, but it is open to serious objections. It is placed here to show the reader what may be done, but not what ought to be done. This operation is incomplete, as the canal and rings are not exposed and dealt with. The structures are also in danger of being bruised, and the free action of the surgeon is prevented by the small opening. The sac, in my opinion, should not be left in the canal. On the other hand the lifting and piling of the external oblique aponeurosis, exposes well the deeper structures, and allows the surgeon to attack at once the inner ring. Correction of the peritoneum at the dilated internal ring causes total obliteration of the sac, and carries it up within the abdomen. The cut rings and canal, removes material that would otherwise favor a relapse. The suturing of the enlarged internal ring re-

stores it to normal size. This closure of the internal ring is the important step of a successful operation.

The following conclusions are now drawn:

1. With careful antiseptic and aseptic precautions, provided the operator is familiar with the anatomical conditions, an operation for the cure of hernia is a comparatively safe procedure.

2. That sterilized chromatized tendon or catgut is the most suitable material for buried sutures.

3. That the wound should be sutured layer by layer separately and accurately, using a continuous stitch.

4. That in the great majority of cases the operation is an entire success, and the per cent of mortality is almost nil.

Irreducible Hernia. This term is applied only to that character of hernia that cannot be returned into the abdominal cavity by intelligent taxis, and where there is no marked obstruction or strangulation present. If either obstruction or strangulation is present to a manifest degree, their importance give to the hernia their characteristics of obstructed or strangulated hernia.

A hernia may be rendered irreducible by adhesions, or by a hypertrophy of the general mass, as it is frequently found where the omentum protrudes. The hernia may be temporarily irreducible, because of distension of the sac with gas, fluid or fecal matter, or by great pressure of the abdominal contents. Muscular contraction of the ring, or inflammatory action, may temporarily prevent the hernia from returning into the abdomen. When these are present they always give rise to pain or uneasiness, and such cases often pass on to strangulation, with intensification of symptoms, unless soon relieved. Warm or cold applications should be used to allay irritability; spraying of ether upon the tumor; fomentations of tobacco and opium may be given to allay peristalsis, and taxis may be employed.

When the hernia is irreducible from adhesions or hypertrophy, having a history of being irreducible, the use of a truss is of no advantage, and the discomfort and danger of injury would be great under such a procedure.

Opening of the sac, dull dissection done with care, ma-
nipulation with the fingers are sometimes justifiable proced-
ures. Often the presence of omentum or intestine adherent
in the neck, or a single adhesive band divided, will set free
the whole mass, but, upon the other hand, many adhesions
may be encountered.

Inflamed Hernia. This condition is generally due to local
injury and may simulate the local symptoms of strangu-
lation. The skin becomes painful, red and hot; the tissues
infiltrated and the sac distended with serum, but the con-
stitutional symptoms of strangulation are absent.

This condition may be relieved by hot or cold applications,
by rest in bed, low diet and the use of anodynes. In some
cases the local inflammation may extend to a general peri-
tonitis, and result in death.

Incarcerated Hernia. Where this condition is present with-
out strangulation, it is usually slow in its development.
A knuckle of bowel has, in all probability, protruded into the
hernial sac and become filled with hard fecal matter. Con-
stipation is present, and the abdomen becomes gradually dis-
tended. Eructations of gas without escape of flatus per rectum
shows the severity of the obstruction. If the obstruction con-
tinues there will be sickness of the stomach, vomiting, and
finally throwing up of fecal matter, thus rendering it difficult
to separate the condition from that of actual strangulation.

The treatment will at first consist of such manipulation
as may be calculated to press the fecal contents from the
knuckle of bowel, and warm fomentations applied to the
tumor. Rest in the recumbent posture with the hips raised.
A quieting opiate may be given at first, care being taken not
to mask the symptoms and be misled by the quieting action
of the drug. Injections of olive or castor oil, plenty of it
may be given.

The writer has often used a half pint of olive oil at an in-
jection and castor oil by the mouth at the same time. Fol-
lowed up with a half gallon or a gallon of warm water, and
castile soap shavings dissolved in the water. Failing in this,
an operation becomes necessary to release the mass.

CHAPTER IV.

STRANGULATED HERNIA.

Symptoms—Seat of Stricture—Treatment—Medical, Taxis, Herniotomy; Artificial Anus—Resection of the Bowel.

Strangulation should always be regarded as a source of danger, and every hour that it continues lessens the chances of recovery. Strangulation is established when the return flow of blood is impeded and the onflow of blood is obstructed in the hernial coil.

Symptoms. The patient directly feels a violent pain in the region of the stomach or near the umbilicus, as if a cord was tied tightly around his body; this is followed by a faint feeling, with eructations, then fecal constipation is obstinate, and the abdomen soon becomes distended with gas. There is a desire to go to stool, but only the fecal matter from the lower bowel passes. The tumor feels hard and sometimes tender to the touch, but often the local symptoms are slight in proportion to the constitutional. If the hernia has been small, the patient may not be apprised of the fact that it has anything to do with his symptoms, and the physician may overlook the cause and take the difficulty to be a mere colic. The pulse is hard and quick at first, and the patient feels and looks anxious. As the symptoms increase the vomiting persists and the feces are thrown through the mouth. The pulse grows more frequent, smaller, but still hard. The abdomen now becomes extremely tender to the touch; the peritoneum is inflamed and the pulse is small, thready and frequent. Hiccough occurs, costiveness continues, the tumor is more tense, and sometimes becomes inflamed on its surface.

Finally the pulse intermits, a cold perspiration is observed, the mind is less concerned, depression ensues, the pain is less, and the patient is more hopeful though the con-

dition is more grave. It must be observed that the pain in the abdomen is reflex and sympathetic, the discharge of vomit, bile and feculent matter is due to reflected peristalsis which takes place above the point of strangulation. The tension of the abdomen at first is due to the gases and subsequently to peritoneal inflammation. The hiccough is a bad omen. It has been accounted a symptom of gangrene, but this is not always the case. The enlarged hernia may be due to pent-up blood, but effusion is often present in the hernial sac, increasing the bulk.

Just before death there is always a copious action of the bowels. Dissolution produces relaxation.

The symptoms of strangulation are not always continuous. At short intervals the patient may be free from pain and suffering, then again they become violent. When gangrene of the sac has taken place, the skin over the tumor may be emphysematous and retain any impression of the finger. Within the sac a bloody serum gathers. The intestine turns first deep red, then brown, and is covered with a coat of glutinous matter. If the sac is opened an offensive smell is emitted and the intestine loses its brilliancy. Under these conditions taxis or finger pressure would easily rupture the intestine. The omentum, when gangrenous, is of a dark color, easily crumbles, and crackles under pressure.

The Seat of Stricture may be at the external abdominal ring, but in the greater number of cases it is at the internal ring, or it is at times within the canal. A small hernia is more easily strangulated than a large one. It occasionally happens that during collapse from complete relaxation a hernia reduces itself, but no physician will wait and trust for such a fortunate event. Delay is dangerous, and efforts for relief should be immediately enforced. The physician should not for a moment lose sight of this fact.

Treatment. Notwithstanding all this, a strangulated hernia is not to be subjected invariably to immediate heroic efforts at reduction. In some cases of old hernia with pain and abdominal uneasiness the mass is not readily reduced. If not of long standing, and the symptoms are not urgent, the

patient should be put at rest with hips elevated and the hernia sustained with equable pressure by means of an elastic bandage. Hot or cold applications may be used, and a hypodermic dose of morphia may be given to relax and produce sleep. This delay, however, is not justifiable where the evidences of strangulation are marked, and vomiting is present.

Opium or morphia is only admissible at such times, and then great precautions should be exercised lest it so masks the symptoms as to lead to a fatal delay.

Taxis. Taxis, like other means, is good only when it is required. Without a perfect understanding of its use and power it is a dangerous procedure. If the strangulation has been long continued, the danger increases.

Taxis is performed in the following manner: The patient is placed in the recumbent position; the head and shoulders are slightly elevated; the thighs are flexed at right angles with the body. The bladder is previously emptied. The surgeon takes his position to the side of the patient, passes his hand down between the thighs, and coming up, he grasps the hernia, and with his thumb and fingers, he kneads the tumor at the upper part of the inguinal canal, or at the supposed location of the stricture. Gentle pressure may be employed by holding the hernia at the same time in the palm of the hand, but it is usually advisable to draw the hernial contents outward, thus lessening the bulk and unlocking the constricted portion.

A strangulated hernia is often sensitive, and pain is excited by manipulation, which opposes reduction. An anæsthetic may be administered. This is a powerful relaxant, and aids in reduction, but still no violent means should be used because of the patient being deprived of sensibility, and more especially is this true when the strangulation has continued for any great length of time. In the later hours of strangulation, when there is likelihood of the bowel being swollen, congested or gangrenous, taxis is hopeless and worse than useless.

A spraying of ether upon the hernia has been known to contract the tissues and empty the excess of blood, and fomentations of tobacco have been recommended to relax the

tissues, but usually the dangers of delay are so great and the safety of an operation so assured, when performed early, that no time should be lost. The manipulation of a strangulated hernia after six hours is of doubtful propriety, and after twelve hours it should not be attempted at all. It is true that reduction has been effected after a longer period than this, but these cases are extremely rare, and the danger of a fatal termination is so much increased by the delay, that we cannot invite procrastination, and it is wiser to proceed at once to the operation.

Herniotomy. The integument, pubes, and scrotum should be shaved, scrubbed with a clean stiff brush, with ethereal or green soap and warm water, and finally bathed with sublimate solution 1-1000. The patient is now placed on the operating table and fully anæsthetized, the hips slightly elevated. The hands and instruments must be clean, and antiseptic solutions at command. The bladder is to be emptied. The first incision is made by pinching up the skin in a fold transverse to the line of incision; an assistant grasps the other end of the fold and holds it steady. The knife is now made to transfix the integument with the back of the blade toward the hernia. With one stroke the external incision is made. If properly pulled up, the incision will be of full length, extending from one inch above the internal ring, to the spine of the pubis below. This method saves time and the incision is made with greater accuracy than cutting from without inward, besides the superficial vessels are lying on the field below and can now be cared for with ease. The line of incision is usually in the axis of the tumor. All bleeding should be arrested at once, first, with hemostatic forceps and if need be, tying with chromatized catgut. The wound may be irrigated with sublimate solution 1-3000 or mopped with an antiseptic pad made of absorbent cotton enclosed in antiseptic gauze. The operator now dissects his way down cautiously to the hernial sac. He must recognize the sac, lest he cut through it unawares. Each structure should be cut upon the director . A small opening is made and the director is slipped through it and the tissue divided the length of the external incision. A " rat-

toothed" forceps lifts the structures, the knife is turned flat and a nick is all that is necessary to admit the point of the director.

When the sac is reached, it is entered in a manner as directed above. Previously, it may be detected by its color and usually smooth surface, and by moving it back and forth, the gases beneath, or serum collection, and the intestine wall may be felt. As soon as the opening is made, the serum will escape. The serum will be clear or straw-colored, in case of recent strangulation, bloody or black looking in case of long strangulation, and there will be necrosed tissue and foul odor in case of a gangrenous bowel or omentum. In some rare cases the sac may be adherent to the intestines, and puncture of the gut has occurred under such circumstances. Even should this accident happen, it is not dangerous, as the opening can be closed by the Lembert suture. As the sac is opened a groove director is made to enter and the sac is divided large enough to admit the finger, and when this is accomplished the sac can be lifted and further divided, as may be indicated. The contents are thus exposed to view. A thorough irrigation should now be made, especially if there be disintegrated matter. A hot boric acid solution is the best, or if the odor is foul, the sublimate solution 1-3000. The strangulation of the neck of the sac prevents the wash from entering the abdominal cavity.

The hands of the operator should now be re-cleansed and search made for the stricture. The nail of the index finger of the left hand, the palmar surface of which is turned upward, can be slipped upward beneath the stricture usually and can often be made to tear the band by pressing directly upward. No harm can be done to the intestine if the pressure is made in this way. If this seems impracticable or cannot be done, a hernial knife is to be used, or if this knife is not at command, take a curved bistoury and wrap the blade, leaving the edge bare for half an inch near the point. Now guide the knife with the point of the finger, to the stricture in front of the hernial contents, push it carefully under the stricture flatwise, until the sharp edge of the knife is parallel with the con-

striction.   The edge of the knife is now turned upward against
the ring and is pressed against.   The knife should be held so
as to point upward and slightly inward toward the umbilicus,
as this position is applicable in both oblique and direct hernias.
The least nick of the knife will so sever the band that it be-
comes an easy matter to complete the work by the finger.
But now comes the responsible part of the task.   Is the bowel
in a condition to return?   Is the sac adherent?   Is there gan-
grene present?   When the stricture is cut or broken, the her-
nial contents are disposed to recede, if not adherent, and care
should be exercised to retain it out, until the operator is satis-
fied as to its condition.   The color of a strangulated intestine
varies from a pinkish gray to a black.   If doubt exists as to
its viability, cover the parts with cloths dipped in hot boric
acid solution and wait from five to twenty minutes to see if
the circulation will be established; if so, return it, taking care
not to allow blood to follow from the wound.   A plug of gauze
can occupy the opening for the time.   No sublimate solution
should be used now, when the fluid can enter the peritoneal
cavity.

If the bowel is gangrenous, it is safe to hold it for a time
and apply the warm boric acid compress, but if it be sphace-
lated—black and friable, it must be kept out, and either an
artificial anus must be made, or a resection of the dead part
with rejoining of the ends of the gut.

If omentum is contained in the hernia, if it is small in
amount, say an inch or two, and is unchanged, reduce it, but
if a pathological change has taken place in its structure it
should be drawn out until healthy omentum is reached, and tied
with catgut, then cut away.

Now, if the condition of the parts and that of the patient
is such as to warrant it, the wound should be closed as in the
radical operation for the cure of hernia.   If the parts are
necrotic the intestinal wall broken down, or if there is danger
of a rupture of the gut, one of the two alternatives must be re-
sorted to, namely, an artificial anus or a resection of the
bowel.

An artificial anus may be preferred in cases where pa-

tients are not in good condition—in a state of collapse or in quite old people, but if the patient is in the prime of life and otherwise healthy, and has not been reduced by his hernial suffering, an exsection of the dead portion and the ends of the intestine sewed together would be the preferable course of procedure.

An artificial anus or temporary fecal fistula is, under the above circumstances made by drawing out the bowel to sound tissue, and stitching it to the ring.

Resection of the bowel is accomplished by releasing the strangulation, drawing down the intestine until five or six inches of the sound gut is exposed, then grasping the intestines with the fingers. An assistant should hold close to the ring, or a broad tape may be tied loosely around each intestine near the ring, to prevent retraction or the escape of feces. With sharp scissors the intestines are divided squarely across, and from thence the mesentery is cut in a V-shape, the base of which corresponds to the section of intestine removed. All bleeding points of the mesentery are now to be ligated with catgut. The gut ends to the tapes, should now be carefully emptied and thoroughly washed with the boric acid solution. The edges of the mesentery are stiched with interrupted sutures and the divided intestine is stitched with the Lembert suture, or joined by means of the Murphy button, which procedure we cannot now explain in detail. The external parts are now adjusted according to instructions given in the radical cure of hernia. A drainage tube should be inserted and antiseptic dressing applied, absolute quiet enjoined, a mild opiate given; a liquid diet kept up until evidences of restored function is present.

CHAPTER V.

FEMORAL HERNIA.

Definition—Anatomy—Symptoms—Reducible—Irreducible—Strangulated—
Diagnosis—Operative Treatment.

Femoral hernia stands next in frequency to inguinal hernia, and is found more commonly in females than in males, owing to the fact that the crural space is largest in the female. It is always an acquired condition.

The superficial fascia covering the external oblique muscle on the abdomen, is continuous down over Poupart's ligament upon the thigh, where it becomes more dense and serves to keep the superficial veins and absorbents in their proper position.

Under Poupart's ligament is a space called the femoral or crural arch, which affords passage to the femoral artery and vein, the anterior crural nerve, and psoas and iliacus internus muscles. From that portion of Poupart's ligament which is inserted into the spine of the pubes, a process is given off which is extended downwards and outwards and is inserted into the ligament of the pubes, over the linea ileo pectinea. It presents a triangular surface, and its border looking outward and toward the femoral vein, is concave. This structure is called Gimbernat's ligament.

Two fasciæ are given off above Poupart's ligament, one passing between the peritoneum and transversalis muscle, which is called the transversalis fascia, or crural septum; another found beneath the peritoneum and iliacus and psoas muscles, and this is the fascia iliaca. Now, the transversalis fascia is lost upon Poupart's ligament throughout its course, except where the femoral vessels escape. At this point the transversalis fascia continues with and forms a part of the

femoral sheath. The iliac fascia continues with Poupart's ligament at its outer half, and constitutes the deep femoral fascia and the posterior layer of the femoral sheath. In this sheath is the femoral artery and vein; the anterior crural nerve is not included.

The vein is internal to the artery, and Gimbernat's ligament lies to the inner side of the vein and is about five-eighths of an inch away from the vein, and this space between the vein and Gimbernat's ligament is the femoral or crural canal.

Under the superficial fascia of the groin is the fascia lata, which has two attachments above, but becomes united below. One attachment is to Poupart's ligament from the anterior superior spine of the ilium to the spine of the pubis, and, passing downwards, covers the femoral artery and vein, the anterior crural nerve, and the muscles on the outer and front part of the thigh. The pectineal fascia is interrupted at about the position of the femoral vein by an eliptical opening measuring about an inch and a half in its longest diameter, designed to transmit the long saphenous vein from the plane of the sartorial or pectineal fascia to the femoral sheath. This is the saphenous opening. It is imperfectly defined below, where the two layers blend, but it is sharply outlined above on the plane of the sartorius or pectineal fascia. This upper edge is crescentric and its concavity is outward and is called the falciform process or Hey's ligament.

The femoral canal is a curved passage and has a somewhat funnel shape, being larger above than below.

The epigastric artery, in its course upward and inward from the external iliac, passes from half to three-fourths of an inch from the opening where the absorbents enter the abdomen. There is, however, considerable variation in the origin of this vessel. and it is well also for the surgeon to recognize the fact that the obturator artery frequently arises from the epigastric, and usually takes a course to the outer side and beneath a hernial protrusion, but occasionally a branch may lie directly in the field of operation.

The coverings of femoral hernia from without inward are

the skin, cribriform fascia, transversalis fascia and the peritoneal sac.

The point of constriction in femoral hernia is found usually in Gimbernat's ligament, just within the canal and at the inner border of the opening. Occasionally it is in Hey's ligament.

Fig. 207. Femoral hernia on the right side.

Symptoms. When a femoral hernia commences, the patient's attention is called to the part by the pain caused in straightening the limb. This is occasioned by the extension of the fascia lata and its pressure on the protruding parts.

On examination, a fullness is discovered at the upper and inner part of the femoral sheath which may disappear on pressure or when the patient is recumbent. The fullness soon increases and it may be seen about the size of a walnut immediately below Poupart's ligament. As the swelling enlarges it projects forward and sometimes turns upward over Poupart's ligament; sometimes sinks downwards into

Fig. 208. Double femoral hernia. Unusually large on the right side.

Scarpa's space, and I have seen it pushing down and outward, lying on the outside of the femoral vessels.

When the tumor is small it may be mistaken for an enlarged gland, or if it coils upward, it may be mistaken for inguinal hernia, in which case very serious mischief might

happen in case of an operation, or attempts at reduction by taxis.

Femoral hernia is most frequently found on the right side, probably due to the employment of that side to a greater degree. Women who have borne many children are more liable to it than others, which perhaps arises from the facts of the extension of the abdominal parieties during gestation, and finally a relaxed state of the parts. Old persons are more frequently affected than the young.

The protrusion of the peritoneal contents is most frequently intestinal, rarely omental, but occasionally both. The appendix vermiformis and the ovary have been found in the hernia in a few cases. Femoral hernia is subject to the same conditions as the inguinal, in that it may be reducible, irreducible, incarcerated or strangulated.

The reducible femoral hernia is in constant danger of strangulation from the small size of the crural canal through which it passes, and hence proper means should always be applied to prevent its descent. The employment of a truss is the only method by which the safety of the patient can be secured without an operation for the cure, but the truss required for femoral hernia must be of somewhat different construction to that of inguinal hernia. The pad must project down farther It must be constantly worn. It is rare, however, that a truss ever effects a cure in this variety of hernia.

Irreducible femoral hernia takes place from adhesions and from the growth of the protruding mass, in which case a truss cannot be worn.

Strangulated femoral hernia. The symptoms of this form are the same as in the inguinal variety, and the treatment is the same except that taxis is employed in a different way. First, the patient should be placed on a table or bed with the shoulders elevated and the thighs bent at right angles; the involved leg should be thrown over the opposite leg to relax the muscular structure about the hernia. If the tumor is hooked over Poupart's ligament this must be recognized. The tumor must be pressed downward and then kneaded upward. An effort should always be made to draw the

strangulated gut down in a straight line and lessen its vol-
ume.   As in the inguinal, so in the femoral, the pressure must
be gentle and continuous, avoiding violence, which might pro-
duce perforation of the intestine or other serious consequences.

As the symptoms of strangulation in this variety of hernia
are usually more violent, and it destroys life more quickly, there
is still greater necessity of an early operation. It is not
meant that an operation is to be made at once without the
employment of the means usually preceding, such as taxis,
ice packs to the parts, spraying of ether upon the tumor, hot
fomentations sometimes, or the hips elevated; but these
means when indicated should be carried through quickly, and
when a failure to reduce is evident, there should be no delay
in performing the operation.

The Operation for Strangulated Femoral Hernia. The hair
should be shaved from the surface and the parts should
be made aseptic and antiseptic by the same method as di-
rected in inguinal hernia.   The patient is then placed on the
table and an anæsthetic administered.   The thigh should be
bent over the other leg and slightly raised at the knee, so as to
relax the parts about the groin.   Without reference to the lo-
cation of the tumor, the incision should be made with the
view of exploring the femoral canal, as that is the point of
stricture.   The first incision should commence over Poupart's
ligament and thence downward and over the crural canal. A
second incision can now be made at right angles with the
first, at the lower end of the first incision, so that the two
together will form an L or if thought best, a ⌐.   The angular
flaps can now be dissected up to allow sufficient space.   The
next step will be to divide the superficial fascia to the same
extent as the integument.   The transversalis fascia may
then be seen, and there is usually a vein of some size
either cut or brought into view—sometimes an artery—a branch
of the obturator.   If a careful dissection is made—enough to
admit the end of the finger or the director, these vessels may
be detected and drawn to one side.   The transversalis fascia
should be opened and the hernial sac exposed.   If the patient
is fat, a layer of adipose tissue may be found between this

fascia and the sac. The fascia propria may be mistaken for
the sac, and care must be taken in detecting points of differ-
ence. The hernial sac having been exposed, it should be
pinched up with the forceps and nicked—an aperture large
enough for the director, upon which it should be further di-
vided. A quantity of fluid usually escapes, which varies
in quantity and quality according to the time strangulation
has existed. The fluid may be entirely wanting, and if the
inflammation has run high there may be adhesions of the sac.

Cutting the Stricture. This is an important step. Its
situation must first be ascertained. It is usually found imme-
diately beneath Poupart's ligament in the striæ of Gimbernat,
but it may at times be found in the fascia lata. The little
finger is the exploring instrument. A director should be care-
fully introduced into the sac anterior to the hernial contents,
and gradually insinuated under the stricture, and the hernial
knife may now be made to glide along the groove of the di-
rector, its cutting edge turned upon the stricture, while the
knife is turned upwards and inwards toward the umbilicus.
The point of the finger may serve as the guide to the knife, as
we have hitherto directed. After division of the stricture, care
should be exercised to prevent the hernial protrusion from
slipping back before a thorough inspection is made. The
neck of the sac should be free and there should be no con-
striction of the mass, and if any disease is manifest it should
be treated in the same manner as that directed in inguinal
hernia.

After the operation the same mode of closing the wound
and the same treatment generally should be given as in the
inguinal variety of hernia.

CHAPTER VI.

UMBILICAL HERNIA.

Congenital—Acquired—Treatment in Infants, and in Adults; Strangulated— Taxis—Operation for Radical Cure—Operation by the Open Method.

Umbilical Hernia is next in frequency to the inguinal. Two varieties present themselves to the surgeon; the *congenital* and the *acquired*. Congenital umbilical hernia is common in both sexes. The protrusion takes place through the opening in the linea alba at the umbilicus, which in the fœtus is the last portion of the abdominal wall to develop and close. At birth the opening usually becomes closed by dense cellular tissue and the remains of the umbilical veins and ductus venosus disappear.

About the third month of gestation, the umbilical vesicle and the omphalo-enteric duct, within its vessels, begin to shrink, and in cases of retarded development a thread-like pedicle may be seen, even at full gestation. Soon afterwards, the tubes of the urachus, occupying the lower part of the umbilical opening, shrink and close, but occasionally there is a delay in development, and when the child is born there may be an opening at the navel through which urine passes. Sometimes the reflected tube of the amnion is found to pass into the umbilical cord and to contain a portion of the small intestine at birth. In such cases the umbilicus is dilated and receives an impulse on crying. If the cord is tied over this, strangulation of the intestine would ensue and death result, perhaps without recognizing the cause. This protrusion is a form of hernia.

Umbilical hernia commences in a small protrusion which resembles the end of the finger in a glove; it may be the umbilicus itself that is made prominent, or at times the protrus-

ion is a little to one side of the umbilicus. If neglected it soon
enlarges so that it pushes below the umbilicus. The
disease may be formed by the protrusion of intestine or
omentum, or both, and is often attended with much danger.
When the intestine has protruded it may be distinguished by
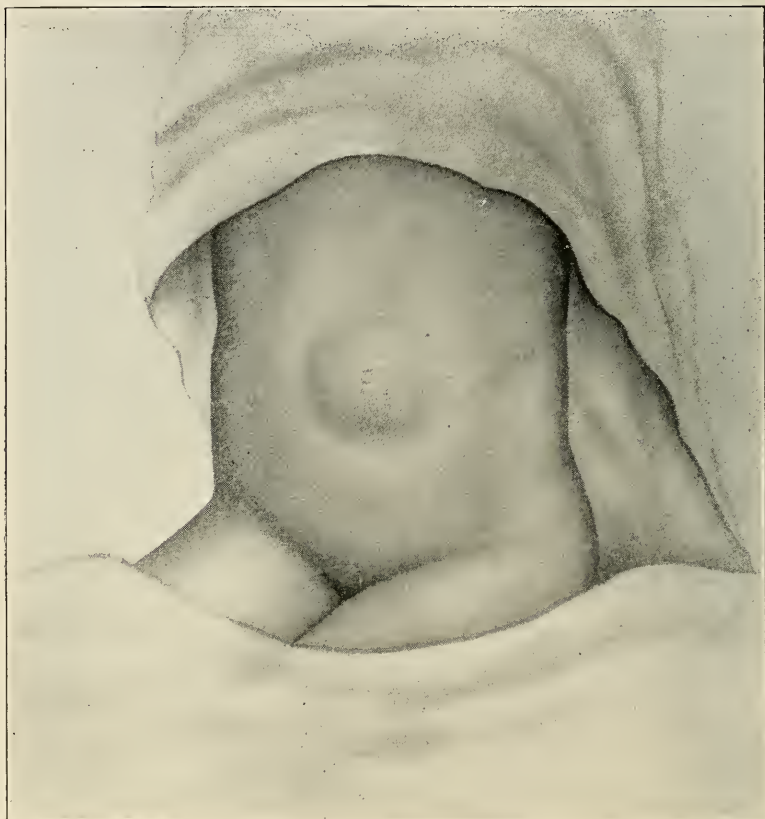
Fig. 209. Umbilical hernia.

its elasticity, its uniform feel and the gurgling of gases. When
it is omental the feel is uneven and doughy. The intestinal
protrusion is attended with uneasiness, the bowels are irregu-
lar and the patient is troubled with flatulence and sometimes
nausea. In the omental form there is but little distress
unless it is strangulated.

Congenital hernia is very common and the children suffer from griping and irregular bowels.

Treatment. It is the physician's duty to teach the mother that such a condition ought not to be neglected. At the beginning of life, nature is making a viogrous effort to brace the weakened state around the umbilicus, and a simple appliance is usually sufficient to restore the parts.

The plan usually adopted is to apply an adhesive plaster, an inch and a half wide and long enough to reach from side to side. By plastering one end to the side and pinching up a couple of folds of the integument—one on each side of the umbilicus, the strap is drawn and laid over so as to press these folds upon the protruding mass. This furnishes tissue that lies idle, and nature contracts it into repair of the weak spot. It is better than a ball or pad, as the pad will place the tissues on a stretch—a thing we do not desire. The whole may be further secured by a linen belt around the body, and by good care the parts will soon be well.

In adults, women are much more liable to umbilical hernia than men. If the patient is thin the tumor is usually quite prominent, but in fat persons the hernia may be almost imperceptible on superficial examination. It may be so blended with fat that its edges are not well defined. Often it is flat and may extend downward or upward in the parietes of the abdominal walls.

Generally the hernia has a peritoneal sac, but in a few instances the sac may be absent.

Umbilical hernia may be reducible, irreducible or strangulated. The evidences of these conditions are not unlike the same conditions in inguinal hernia.

In umbilical hernia in adults, as a palliative treatment and to prevent further accident, a truss may be worn. The pad of the truss should not merely cover the opening but it should extend considerably over the abdomen, so as to press on a larger space and thus support the walls. The pad can be secured with a spring or, better still, by an elastic belt around the body. There are numerous styles of trusses on the market, from which the surgeon

may select for his individual case. If the hernia is irreducible, a truss with a hollow pad to fit over the mass will give it support and possibly prevent further enlargement, but if the hernia is very large, this kind of truss cannot be worn, and all that can be done in such a case is to support the hernia with an abdominal bandage (woven rubber is the best) and have it supported by shoulder straps.

Treatment of Strangulated Umbilical Hernia. Place the patient in the recumbent position upon the back, raise the shoulders and flex the thighs at right angles with the body.

The surgeon now grasps the swelling with the hand and kneads the edges with the points of his fingers while he presses upon the protrusion. A steady pressure for half an hour will often cause it to settle back. Should this fail, place the patient under an anæsthetic and repeat the taxis as above. Should this fail, the remedies suggested in the treatment of strangulation in the other hernias may be employed. A tobacco clyster has been recommended. It is no doubt a powerful relaxant, but it is extremely dangerous. I would prefer nausea from lobelia and ipecac, and in many instances have known these to effect relief, but should the hernia continue the operation is next in order.

Operation. This is a simple procedure and only requires a knowledge of what is to be done and the exercise of due caution.

The patient is duly prepared antiseptically and placed on the table with shoulders slightly raised, and then the last effort at taxis is made. If the tumor is large, it should be lifted up from the viscera below.

An incision is made on the median line from the umbilicus down to the lower border of the hernial opening, care being taken, because of the thinness of the walls. The sac is reached by careful dissection upon the director. A couple of napkins dipped in a hot solution of boric acid should be ready to spread on the abdomen on each side of the hernia to receive and take care of any intestines that are liable to protrude. The sac should be pinched up and opened by the scalpel held horizontally. The opening into the abdomen can be enlarged by

the fingers and the sac is split up on the median line, carefully avoiding the bowel. The loop of bowel should now be lifted and search made for the constriction. The stricture is now cautiously divided, usually at the lower border of the opening. The bowel and omentum should be examined closely. If the bowel be ulcerated, the injured part should be drawn a little way out of the cavity to prevent any fecal matter or pus from falling into the abdominal cavity. If the bowel has lost its lustre, if deep black, and has a putrefactive smell, an opening should be made in it, and the bowel drawn out till healthy gut is reached. It should then be stitched with antiseptic silk to the sides of this cutaneous incision. One or two stitches may be made on each side before opening the bowel, to prevent retraction, and some large aseptic sponges dipped in the boric acid solution should be ready to receive the fecal outpour. If the bowel be only red, or of a chocolate color, it may be returned. If doubt exists as to the vitality of the protrusion, secure the parts temporarily, and place the hot napkins made wet in the antiseptic solution over the parts, and wait from fifteen to thirty minutes. After the constricting bands are cut it may take a little time for the circulation to be re-established. The rule is, if there is any life at all in the gut, seek to save it, but if sphacelous, restoration is impossible. Examine the omentum; turn it up over the upper edge of the opening; if the omentum is diseased, you can deal with this with a little more impunity; if gangrenous or sphacelated, tie the vessels with chromatized catgut carried around them, and cut off the mass with scissors. Before the parts are released all bleeding points should be checked. There should be no haste at this point. The stump of omentum should be secured to the lower edge of the incision, so that when adherent it will guide the intestines to a point below, thus preventing any further protrusion. It is well to make a neat job of the omentum and tie each vessel by transfixing it with a needle. Several little stumps are better than a big bundle of puckered omentum. It is a little unfortunate to have a patient coughing at the time of the operation. The bowels are almost cer-

tain to be forced out. If such a condition is present before the incision is made, a delay until the cough seems to be under control is the best course, and to prevent its occurrence at the time, a little skill in the administration of the anæsthetic will do much. If the bowels protrude there should be no indiscriminate handling, and they should be protected by warm wet towels. Always return the intestines before the omentum; then, if possible, spread the omentum out over the intestines.

The stitching should be put in closely and a firm hold made by inserting them from a fourth to half an inch from the edge. In some cases the sac should first be removed. The peritoneal coat should receive a row of stitches with catgut, and the rest of the abdominal walls, should be secured by buried sutures, but my preference is silver wire suture passing through all the structures, taking a good hold of the recti muscles and sheath. The skin may be sutured also with more superficial silk sutures between the wire. The whole is then covered with gauze, this covered with absorbent cotton and then overlaid with rubber tissue that reaches beyond all underdressing, so as to lay adherent to the skin. If an artificial anus is unavoidable, the gut should be well sutured to the edge of the skin so as to prevent any leakage into the abdominal cavity. Frequent dressing will become necessary to keep the parts cleansed of fecal matter.

The Radical Cure of Umbilical Hernia. As a rule, if congenital or infantile cases are treated properly by means of truss pressure, nothing more will be required to effect a cure. If, however, a failure should occur, an operation would become necessary.

The operation should be performed in very much the same way as has been described under strangulated umbilical hernia. Under anæsthesia and the usual precaution, the parts are exposed by incision, the structures properly adjusted and the repair made in a complete and perfect manner.

If a superabundance of stretched skin is present, it must be dissected away. It is best to make an eliptical incision embracing the hernial protrusion. This incision is made

through the skin only, and a little back of the hernial border. This portion of skin is now taken off entirely. If the peritoneal sac is adherent to the borders of the rectus muscle, it must be carefully separated. Silver wires, or strong antiseptic silk, is used for sutures, bringing the sutures out at the incised border of the skin, a little back of its margin.

The sutures are all inserted before any attempt is made at tying, and the ends left sufficiently long to allow a firm hold in closing the wound.

The edges of the recti muscles are excoriated to excite adhesion and the margins are then drawn together, which causes an infolding of the peritoneal portion that has not been severed. The wound is now dressed antiseptically. There should be no haste in taking out the stitches, and other things being equal, they are allowed to remain ten days or two weeks.

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CHAPTER VII.

OTHER FORMS OF HERNIA.

Ventral Hernia—Definition—Treatment—Ischiatic Hernia—Obturator Hernia —Pudendal Hernia—Vaginal Hernia—Phrenic Hernia.

Ventral Hernia. The word ventral signifies *belly*. It is a direct hernia occurring in any part of the abdomen, most frequently found in the linea alba or linea semilunaris. When it takes place below the xiphoid cartilage it may be called *epigastric* hernia; when in the loins *lumbar* hernia. It is caused by a natural deficiency of tendinous structures, or by traumatism in which the continuity of the walls of the abdomen are injured. The greater number of cases occur as the sequel of abdominal section that has been made for the removal of tumors. Where an imperfect apposition of the structures through insufficiency of suturing or premature removal of sutures, or where there is undue strain before the parts have regained sufficient strength it may occur.

Ventral hernia may be simple, multiple or massive. The *simple* variety consists in apparent stretching of the walls of the abdomen, and may be accompanied by an overlying mass of fat, so that the muscles are buried from sight. The muscles as a rule do not lose their function except that there is a weakened state of the abdominal wall, and the sense of insufficient support at the seat of hernia. The patient may not be conscious of any pain or great inconvenience.

The *multiple* variety is more complicated. There is a retraction of the muscles and fatty tissue, and the covering over the hernia is thin. It gives rise to a sense of weakness and insufficiency of the abdominal wall, and may incapacitate the person from labor.

The *massive* variety is indicated by the name and may protrude as large as a child's head or even larger.

There is usually a well-defined marginal ring around the border of a ventral hernia, and the peritoneum may undergo considerable thickening and may have folds or pouches.

The intestinal mass may be reducible, irreducible, incarcerated or strangulated, though the danger of strangulation in ventral hernia is not great. The danger is rather that the rent in the abdominal wall will increase and the volume of hernial protrusion will increase in proportion.

Treatment. The symptoms and treatment of this variety do not need much special consideration, as they are dealt with in a manner similar to the other forms which have already been considered.

Elastic pressure, with suitable pads, will best fill the requirements of a truss.

The question arises whether it is advisable to submit to an operation for a radical cure. This depends upon whether the condition gives great inconvenience. If the proper support cannot be afforded an operation ought to be resorted to.

The operation is similar to that advised for umbilical hernia. Except in old voluminous hernias, in which the retraction of the borders has been considerable, it is well to open the peritoneal cavity and dissect out the superfluous tissue and possibly tie off the sac.

Ischiatic Hernia. This is a protrusion of some portion of the abdominal viscera through the ischiatic opening and situated under the gluteus muscles, protruding either above or below the pyriformis muscle. It is usually small and obscure and it may exist without giving any local evidences of its presence except on firm deep pressure. If it is associated with any symptoms of strangulation, and there is no local evidences of the protruding mass, it would be exceedingly difficult to account for the symptoms, or, rather, to locate the point of constriction. If the hernia has been discovered and strangulation should be present, and no relief afforded by manipulation, the case would justify an exploration.

Obturator Hernia. In this character of hernia the viscus

escapes at the upper part of the thyroid foramen. If any tumor is discovered it will be found below the horizontal ramus of the os pubis, a little to the inside of the femoral vessel, deeply seated and difficult of diagnosis. Indeed, a number of cases have been recorded that were diagnosed only after death. Pain is a frequent accompaniment of this variety of hernia, as the tumor usually encroaches upon the obturator nerve. If strangulation should occur with no relief from the ordinary methods of reduction, an incision parallel to the femoral vessels and midway between these vessels and the pubic spine will enable the operator to reach the sac.

Pudendal Hernia. An inguinal hernia in the female may traverse the inguinal canal or canal of Nuck and reach the labia, but that which is denominated *pudendal*, escapes at the inner side of the ascending ramus of the ischium and presents itself in the posterior part of the labium, thus differing from an inguinal hernia. The situation of the swelling, and its want of connection with the abdominal ring, sufficiently distinguishes it from the inguinal, but it must be remembered that cysts occasionally develop in this locality and hernia should not be confounded with them.

A bandage, pad or truss may prevent an increase of the disease, but cannot retain the mass within the abdomen. If strangulation should occur the sac must be reached and carefully opened, and the stricture divided inwards toward the vagina, care being taken not to injure the bladder.

Perineal Hernia. This hernia escapes between the bladder and rectum in the male, and between the rectum and vagina in the female. The reflected peritoneum between the bladder and rectum becomes involved in the protrusion. This occurrence may take place without external signs, as in a case related by Sir Astley Cooper, who made the discovery in the dissecting room, and one given by Bromfield, where in cutting for stone in a lad of seven years the condition was discovered. Scarpa met with a case in which the hernia formed a tumor in the perineum. We have never seen an instance of the kind.

Vaginal Hernia. This condition may occur by a protru-

sion of the bladder, the rectum or intestine pushing down the vaginal wall. To correct the difficulty the vaginal wall needs support, or the operation of *elytrotomy* may be performed.

PHRENIC HERNIA. The abdominal viscera may protrude through the diaphragm at its natural openings constructed for the passage of the œsophagus, aorta or vena cava, and through the openings occurring from wounds in this membrane. In such an occurrence the patient suffers from interrupted respiration and cough, symptoms of cardialgia, vomiting, etc. The symptoms are so much like other ailments that it is with difficulty that a diagnosis may be made. When these symptoms date from an injury the suspicions may lead to a diagnosis. The hope of relief lies in a laparotomy.

STRANGULATION OF THE INTESTINE WITHIN THE ABDOMEN. The intestine may protrude through an aperture in the mesentery, mesocolon, or omentum. Sometimes an adhesive band, a congenital diverticulum or blind pouch of the mucous or serous coats—the muscular coat having given way, or a long appendix vermiformis, may entangle the intestine.

The precise nature of strangulation from any of the above structures cannot be ascertained without an exploratory incision. Where symptoms of strangulation take place and no protrusion is discoverable through the walls of the abdomen, there is not only a justification, but an absolute necessity for opening the abdominal parietes to make search for the constricting portion and to release the hernia. Formerly it was held that as the precise diagnosis of such cases could not be made during the life of the patient, there could be no benefit derived from surgical aid. This theory is now exploded and we are often justified in opening the abdomen in order that a perfect diagnosis be made.

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